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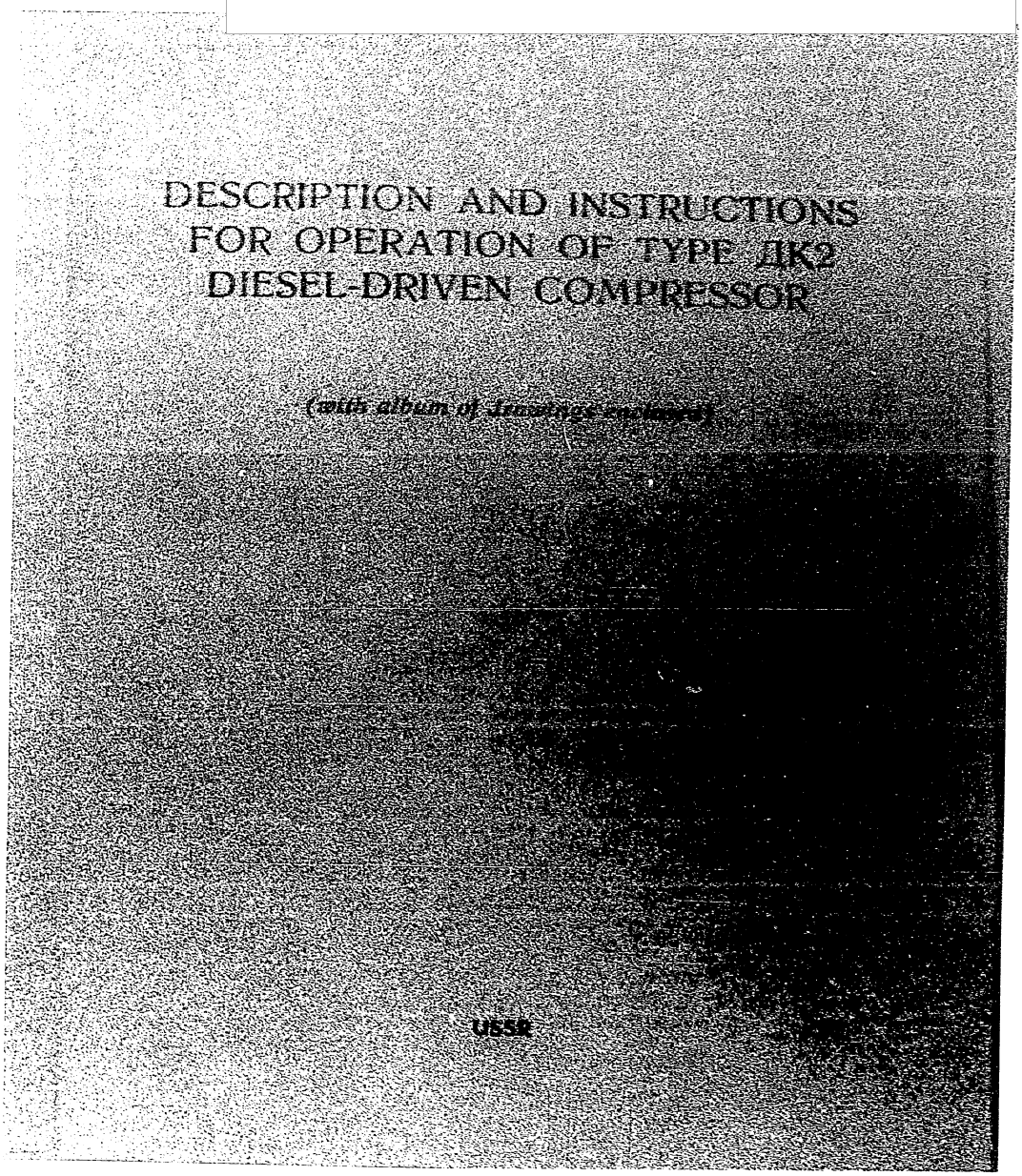

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CONTENTS

I. GENERAL

A. TYPE AND APPLICATION

The type ДК2 Diesel-driven compressor is a set of a four stage high pressure compressor and a two-cycle single-cylinder internal combustion engine with a straight-through-port scavenging system built as a single unit in a common casing. The Diesel-driven compressor is designed for compressing air up to a pressure of 230 kg/sq. cm.

Two versions of the Diesel-driven compressor are manufactured, these differing from each other only by the pressure maintaining valves and by the connection dimensions of the discharge and starting air pipings.

The version No. 1 of the type ДК2 Diesel-driven compressor is provided with a pressure maintaining valve and connection dimensions for piping 18×4. The Diesel-driven compressor is intended for operation at the exhaust static counter-pressure not exceeding 50 mm Hg (with individual gas exhaust device).

The version No. 2 of the type ДК2 Diesel-driven compressor is provided with a pressure and temperature regulator and connection dimensions for piping 22×3.

The Diesel-driven compressor is designed for operation at exhaust increased pulsing counter-pressure up to 220 ± 150 mm Hg (cooperative operation of the Diesel-driven compressor with the main engines for common exhaust).

The maximum counter-pressure is established for each case depending on the installation place of the Diesel-driven compressor.

B. MAIN TECHNICAL DATA

1. The output of the Diesel-driven compressor at intake air temperature of 20° C, suction (barometric) pressure 760 mm Hg, discharge air temperature 30° C and exhaust counter-pressure 50 mm Hg is as follows:

8 litres/min. at the pressure of 230 kg/sq. cm in the 4th pressure stage and fuel consumption of 8.8 kg/hr;

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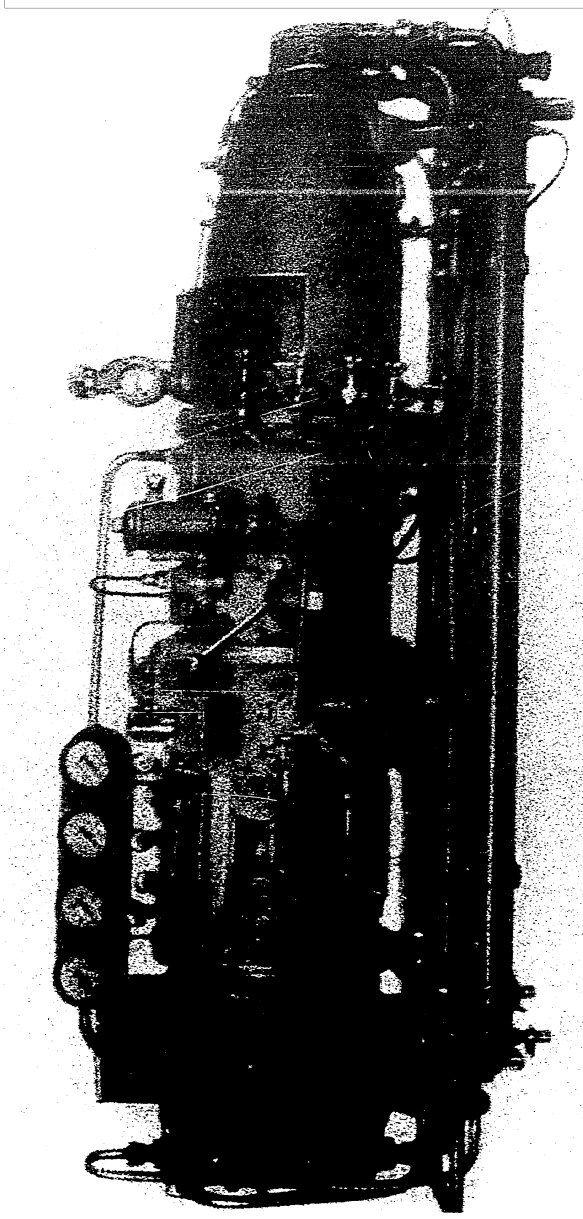

General View of AK5 Diesel Driven Compressor
Version No. 1

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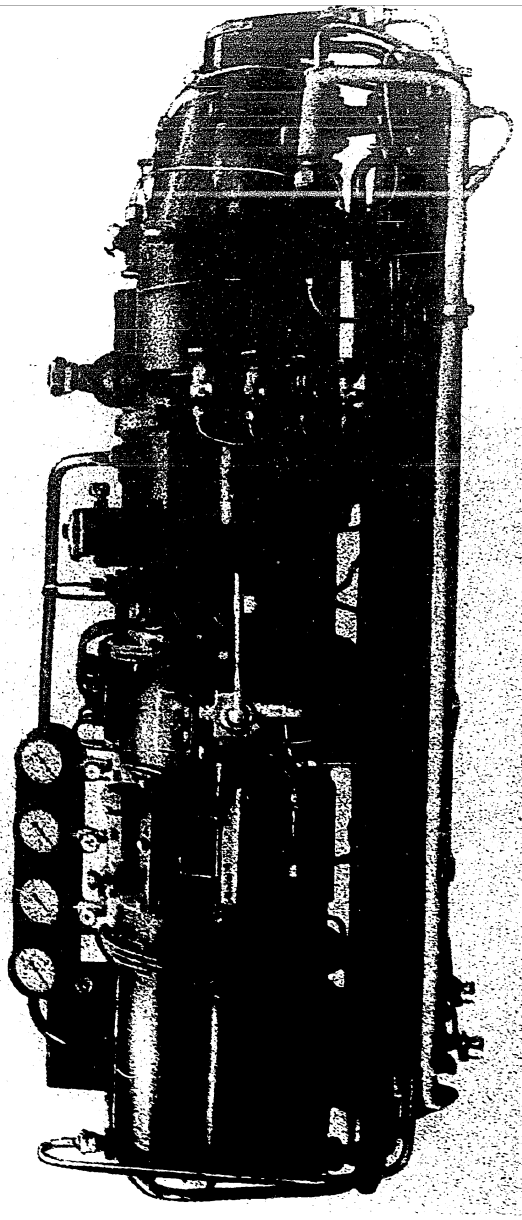

General View of JK2 Diesel-Driven Compressor
Version No. 2

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9 litres/min. at the pressure of 205 kg/sq. cm in the 4th pressure stage and fuel consumption of 8.8 kg/hr;

12 litres/min. at the pressure of 150 kg/sq. cm in the 4th pressure stage and fuel consumption of 7.5 kg/hr.

2. The pressure in each stage of the compressor with different pressures in the 4th stage may be seen below:

Pressure in 4th stage, kg sq. cm	Pressure in stages, kg sq. cm		
	I	II	III
150	3—4	13—16	46—52
205	3—4	14—17	53—58
230	3—4	14—17	55—64

3. The maximum permissible pressure after the 4th stage of compression is 250 kg/sq. cm.

4. Starting is effected with compressed air. The maximum pressure in the starting air bottle is 150 kg/sq. cm. The capacity of the starting air bottle is 33 litres which is sufficient to start the compressor about 10 times without refilling the bottle.

The pressure of starting air after the reducing valve is 26 to 30 kg/sq. cm.

5. Cooling is a forced circulation of fresh or sea water, the water pump being a single-blade double-acting unit.

6. Lubrication is force-fed and dosed by a 10-plunger lubricator with a slide-valve distribution arrangement.

Lubricant: Diesel lubrication oil ДП-11, ГОСТ 5304—54 (with addition of ЦИАТИМ-339 3% dope).

7. Fuel is a Diesel fuel oil, special "ДС", ГОСТ 4749—49. The fuel injection pump is a single-plunger type.

8. The fuel injection nozzle is of the open type and is fitted with a knife-edge filter.

9. Engine performance data:

Nos	Description	Designation	Unit	Air pressure at compressor discharge, kg/sq. cm		
				150	205	230
1	Piston stroke	S	mm	218—220	218—220	218—220
2	Number of double strokes	n	double str. min.	825	875	910
3	Compression ratio (actual)	ε	—	24	30	35

Nos	Description	Designation	Unit	Air pressure at compressor discharge, kg/sq. cm		
				150	205	230
4	Mean piston speed	C_m	$\frac{m}{sec.}$	6.05	6.4	6.6
5	Mean indicated pressure related to full stroke	P_i	$\frac{kg}{sq.\ cm}$	6.5	6.7	6.9
6	Indicated power	N_i	hp	≈55	≈60	≈64
7	Indicated fuel consumption	G_i	gr/hp/hr	145	143	138
8	Maximum combustion pressure	P_z	$\frac{kg}{sq.\ cm}$	—	—	135
9	Scavenging air pressure	P_s	$\frac{kg}{sq.\ cm}$	0.17	0.18	0.18
10	Air surplus ratio at combustion	α	—	1.75	1.74	1.72
11	Air surplus ratio at scavenging	φ	—	1.15	1.10	1.05
12	Temperature of exhaust gases at a back pressure of 50 mm. Hg	t_g	°C	350	365	375

10. Cylinder diameters of the Diesel-driven compressor:

engine . . . . . 115 mm
1st stage of compressor . . . . . 210 mm
2nd stage of compressor . . . . . 105 mm
3rd stage of compressor . . . . . 42 mm
4th stage of compressor . . . . . 24 mm

11. Overall dimensions of the Diesel-driven compressor:

length . . . . . 2,200 mm
width . . . . . 890 mm
height . . . . . 820 mm

12. Dry weight of the Diesel-driven compressor (without silencer and frame) . . . . . [redacted]
Weight of water and oil . . . . . [redacted]
Weight of silencer . . . . . [redacted]
Weight of frame with shock absorber . . . . . [redacted]

II. DESCRIPTION

A. GENERAL DESCRIPTION AND DESCRIPTION OF INDIVIDUAL UNITS

1. GENERAL DESCRIPTION OF DIESEL-DRIVEN COMPRESSOR DESIGN

(See album sheets 1, 2, 3, 31 and 32)

The Diesel-driven compressor consists of three main units which are located (when looking at the compressor from the operating side) as follows: engine *6* is the central part of the set, group of the 2nd—3rd pressure stages *8, 9, 10* at its right and that of the 1st and 4th stages *1, 2* at its left. The 1st stage of the compressor also performs a duty of a scavenging pump. Silencer-filter *19* is secured to flanges on the 1st stage casing and on the cover of the 1st and 4th stages.

Arranged on the engine casing at the operating side are: fuel injection pump *24* with a filter and float chamber *5* and hand-operated starting valve *14*. At the opposite side are mounted water pump *21* and lubricator *20*, both operating from a common drive.

At the top of intermediate casing *4* there are provided automatic starting mechanism *25*, with pressure gauge board *3* above it.

Air coolers *15, 16, 17, 18* for all the four stages of the compressor are suspended underneath the compressor set. The 4th stage safety valve *12* and pressure maintaining valve *11* for version No. 1 or pressure and temperature regulator *13* for version No. 2 are fitted in the piping after the 4th stage air cooler at the right side of the machine. The cooling water outlet pipe is provided with sight glass *22*.

The exhaust gases from the engine are released through the exhaust pipe to the silencer, then to the atmosphere.

The motion mechanism of type ДК2 Diesel-driven compressor consists of two opposed reciprocating piston units.

Each piston unit is a direct connection of the engine power pistons to the compressor pistons.

Protective copper screws *92* are fitted in the cylinder covers of the 1st and 2nd pressure stages to prevent damage to the covers in the event of possible increase in the piston stroke when starting the compressor.

To restore this operation provision is made for a synchronizing mechanism ensuring equal piston stroke of the both piston units. At the operating side the gears of the synchronizing mechanism are used for driving the fuel injection pump as well as the lubricator and the water pump from the opposite side.

2. OPERATING PRINCIPLE OF DIESEL-DRIVEN COMPRESSOR

(See album sheets 4, 31 and 32)

The first stroke on starting the Diesel-driven compressor during which the fresh air in the power cylinder is compressed to fuel ignition temperature is initiated by the expansion of the starting air supplied to the compressor cylinders.

On the ignition of the fuel the combustion products in the power cylinder expand and push the pistons from the inner dead centre to the outer one (forward stroke) which motion results in compression of the air in the compressor cylinders, the air being forced into the air coolers. During the first half of the stroke the forces acting on the pistons considerably exceed the resistance of the air being compressed in the compressor cylinders and the friction forces, the excess of the gas expansion work in the power cylinder being converted into the kinetic energy of the piston units. But in the second half of the stroke the resistance of the compressed air in the compressor cylinders begins to increase exceeding the motive forces of the gas expansion work in the power cylinder, and further progress of the power pistons to their outer dead centres takes place due to kinetic energy accumulated by them. When the power pistons are 165 mm away from the injection-nozzle centre line, the exhaust ports open and the exhaust gases begin to escape, while further retreat of the pistons to a distance of 192 mm from the nozzle centre line open the scavenging ports, thus beginning the scavenging process during which the power cylinder is cleaned from the exhaust gases and filled with fresh air from the receiver. As their kinetic energy is spent, the piston units come to rest, this position being conventionally called "outer dead centre" (ODC).

The back stroke of the piston units takes place due to the expansion work of the compressed air remaining in the dead space of the compressor cylinders. In the first half of the back stroke the excess of the compressed air expansion work is converted into the kinetic energy of the piston units which is accumulated by them, enabling the compression of the air in the power cylinder and the forcing of the scavenging air into the receiver during the second half of the stroke. Suction in the compressor stages also takes place at the back stroke of the pistons. Fuel is injected and ignites at the end of the back stroke. Having spent their

kinetic energy, the piston units come to rest, this position being conventionally called "inner dead centre" (IDC).

The air being drawn in the Diesel-driven compressor passes the silencer-filter and further takes two ways: one leading to the scavenging pump and the other into the compressor 1st stage cylinder.

During the first half of the forward stroke the 1st stage of the compressor performs the function of a scavenging pump.

Air compression is accomplished successively in four stages. The air is cooled in the air coolers after each stage of compression. A pressure maintaining valve or, depending on the version of the Diesel-driven compressor delivered, a pressure and temperature regulator set for a pressure of 150 kg/sq. cm are provided at the discharge of the 4th stage.

The design features of type 1K2 Diesel-driven compressor render a number of advantages over conventional reciprocating compressors of the same output, such as:

1. full balance of the compressor enabling the installation of the machine without any special foundation;
2. smaller weight which is about ⅓ of the weight of an electrically driven compressor;
3. small size;
4. considerably economy in fuel consumption per 1 litre of compressed air;
5. complete independence of operation due to no necessity in outside sources of energy (steam or power) supply;
6. small consumption of lubricating oil due to absence of any loaded bearings and thanks to accurate dosing of the lubricant.

3. ENGINE

(See album sheets 5, 31 and 32).

The prime mover of the compressor is a two-cycle single-cylinder compression-ignition engine with opposed reciprocating pistons and a straight-through-port scavenging system. For the type of its motion mechanism it belongs to free-piston engines since it has no crank gear to ensure fixed outer and inner dead centre positions at any duty.

In the type 1K2 Diesel-driven compressor the engine proper consists of the following units: an engine casing, intermediate casing that forms the scavenging air receiver, power cylinder, power pistons, fuel injection pump with a nozzle, starting gear and a scavenging pump. The piston units and the synchronizing mechanism are common for both the engine and the compressor, the water pump and the lubricator also effect the service of both the engine and the compressor.

The engine casing consists of two parts: engine casing *31* and intermediate casing *30* bolted together. Pressed in the engine casing is steel cylinder *32* with an internal cast-iron liner. Provided in the left part of the cylinder are 12 scavenging ports located tangentially and in its right part are 7 exhaust ports located tangentially and radially.

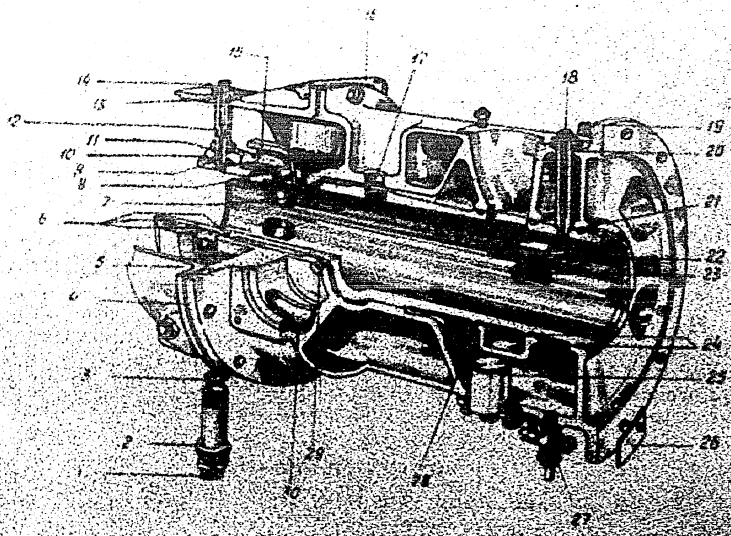

Fig. 1. Engine

1 — cooling water inlet; *2* — packing ring; *3* — gasket; *4* — gasket; *5* — intermediate casing; *6* — packing ring; *7* — scavenging ports; *8* — gasket; *9* — gasket; *10* — holder; *11* — packing ring; *12* — gasket; *13* — packing ring; *14* — oil pipe connector; *15* — hand plug; *16* — through hole for lubricator mounting; *17* — hole for nozzle; *18* — oil pipe connector; *19* — [illegible] outlet; *20* — packing ring; *21* — gasket; *22* — power cylinder; *23* — exhaust ports; *24* — [illegible] ring; *25* — protector; *26* — gasket; *27* — drain cock; *28* — packing ring; *29* — [illegible] ed rack guide bush

Pressed on the cylinder end at the side of the scavenging ports is clip *27* that forms a water space around this part of the cylinder. Connector *37* is turned into the clip, which admits the cooling water. The cooling water flows inside clip *27*, enters the engine water jacket via pipe connection *39* and is led out through connector *38*. The water spaces are hermetically sealed and separated from the air spaces by means of rubber rings *28, 29, 34*. Protector *36* is fitted in the lower part of the engine casing (in the water space) and water drain cock *35* is screwed in closely to it. The lubrication of the internal surfaces of the cylinder is

effected via connectors *26* and *33* screwed in at the ends of the engine cylinder.

Mounted on the engine casing at the operator side is fuel injection pump *24* with a filter and a float chamber. The pump forces the fuel into the power cylinder through nozzle *23* fitted in the middle of the cylinder. The fuel injection pump is driven by gear *127* of the synchronizing mechanism, the gear being pressed on fuel pump shaft *111*. Gear *127* is in mesh with toothed racks *57* sliding in guide sleeves *307* pressed in the engine casing.

At the left of the pump is hand-actuated starting valve *14* fastened on a bracket to the intermediate casing flange. Water pump *21* with its drive is installed on the opposite side of the engine casing.

The intermediate casing is an iron casting with two flanges and a reservoir which is filled with oil and houses the lubricator. The casing has two rectangular inspection ports and a rectangular opening with a flange for the accommodation of the automatic starting mechanism. In the lower part of the casing are provided a box-type lug for collection of waste oil and a drain cock.

The engine casing and the intermediate casing are provided with mounting feet by which the Diesel-driven compressor may be secured to the frame or to the wall. On ships the Diesel-driven compressor is mounted on type AKCC-400M frame fitted with four shock absorbers and supplied with the compressor set.

4. MOTION MECHANISM

(See album sheets 6, 7, 31 and 32)

The motion mechanism is common for the engine and the compressor, it consists of two opposed reciprocating piston units and two gears rotating alternately through an angle of about 260°. The cross-members, racks and gears of the motion mechanism compose the synchronizing gear.

The exhaust side piston unit incorporates pistons of the 2nd and 3rd stages of the compressor, the power piston, the cross-member and two toothed racks. The 2nd stage piston *45* is integral with its rod and has four compression rings *53*. The rod is used for connection to power piston *42* through the medium of pin *43* and castle nut *44*. The power piston is fitted with three compression rings *41* and has flame ring *40* to protect the compression rings from overheating. All the four rings are screw-fixed against turning. Cross-member *47* is rigidly secured in the middle of the rod of the 2nd stage piston by means of pin *46*. Two toothed racks *57* are attached to the ends of the cross-member by means of hollow pins *56*.

Fitted inside the 2nd stage piston rod is the piston assembly of the 3rd stage that consists of piston *54* and rod *52* connected together and ball-pivoted to the piston of the 2nd stage. The piston of the 3rd stage has five piston rings.

The scavenging side piston unit incorporates the pistons of the 1st and 4th pressure stages, the power piston, the cross-member and the two toothed racks. The piston of the 1st stage is made integral with its rod and is fitted with two compression rings. Power piston *42* and the method of its attachment are the same as at the exhaust side. Cross-member *47* is pivot-connected to the rod in its middle part by means of pin *66*, and two toothed racks *57* are secured to the ends of the cross-member with hollow pins *56*. Fitted inside the rod of the 1st stage piston is the piston assembly of the 4th stage that consists of piston *58* and its rod *61* connected to the rod of the 1st stage in a manner similar to that of the piston assembly of the 3rd stage. The 4th stage piston is fitted with twelve compression rings *70*. Since the piston rings are small in diameter, the 4th stage piston is made composite.

Both piston units of the exhaust and scavenging sides are made strictly equal in weight, the allowable difference being not greater than 10 grams.

Since the January 1, 1965 Diesel engine pistons of changed design are used, the weight of those pistons is greater for 600 grams in comparison with the earlier installed. It should be had in mind in case of replacing the piston units.

5. COMPRESSION SECTION

The compression section of the Diesel-driven compressor consists of two groups:

a) the 1st and 4th stage compression group arranged at the engine scavenging side;

b) the 2nd and 3rd stage compression group arranged at the engine exhaust side.

1st and 4th Stage Compression Group

(See album sheets 8, 9, 31 and 32)

The 1st and 4th stage compression group consists of the 1st stage casing, the 1st and 4th stage cylinders, the 1st stage valve cover, the scavenging pump valve board and the 1st and 4th stage cover.

The 1st stage casing *71* is an iron casting of intricate outline provided with a flange by which it is bolted to intermediate casing *30*. Inside the 1st stage casing *71* are provided cast partitions and channels that separate the air and water spaces. Pressed in the 1st stage casing *71* is the 1st stage cylinder liner

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76 with valve cover 303 fitted on its outer end. The valve cover incorporates at its face thirty one suction valves 155 of the 1st stage. Provided in the cylindrical part of the liner are twenty

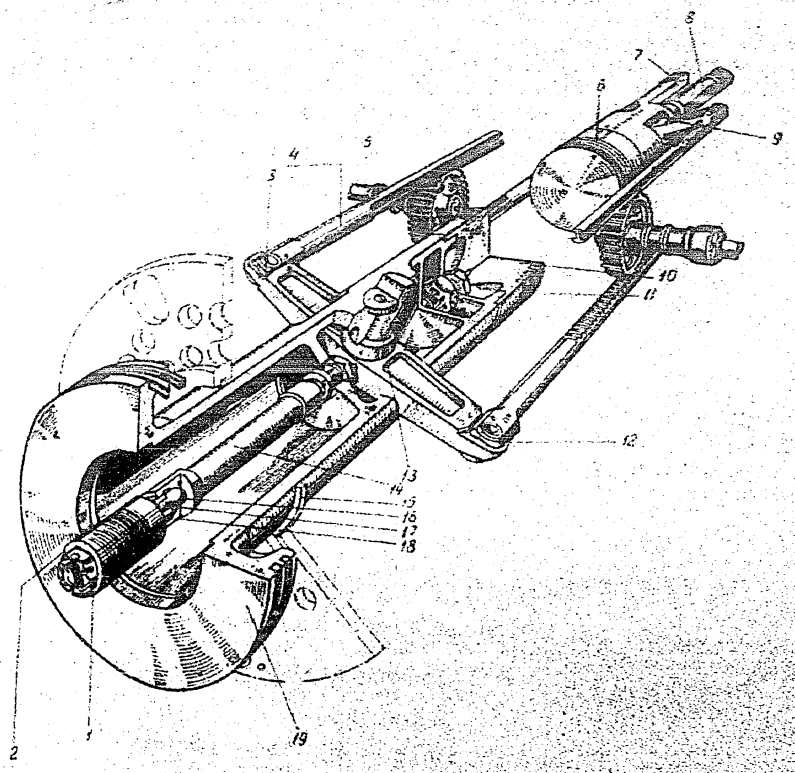

Fig. 2. Motion Mechanism

1 — cotter pin; *2* — 4th stage piston; *3* — bushing; *4* — toothed rack; *5* — water pump drive shaft; *6* — power piston; *7* — 2nd stage piston; *8* — 3rd stage piston rod; *9* — cross-member; *10* — power piston; *11* — piston ring; *12* — cross-member; *13* — cross-member pin; *14* — 4th stage piston rod; *15* — packing ring; *16* — pin with ball head; *17* — ring stop bearing (split type); *18* — pressure nut; *19* — 1st stage piston

four discharge valves *304* of the 1st stage. Three copper screws *92* are turned into valve cover *303* at the 1st stage cylinder side to limit the travel of the pistons.

At its opposite end the 1st stage cylinder is closed with valve board *65* incorporating thirty one discharge valves *64* of the

scavenging pump. Twenty four discharge valves *126* of the scavenging pump are arranged circumferentially at the middle part of the 1st stage cylinder. These valves are communicated with the air receiver through five longitudinal passages provided in the casting of the 1st stage casing. Thirty suction valves *77* of

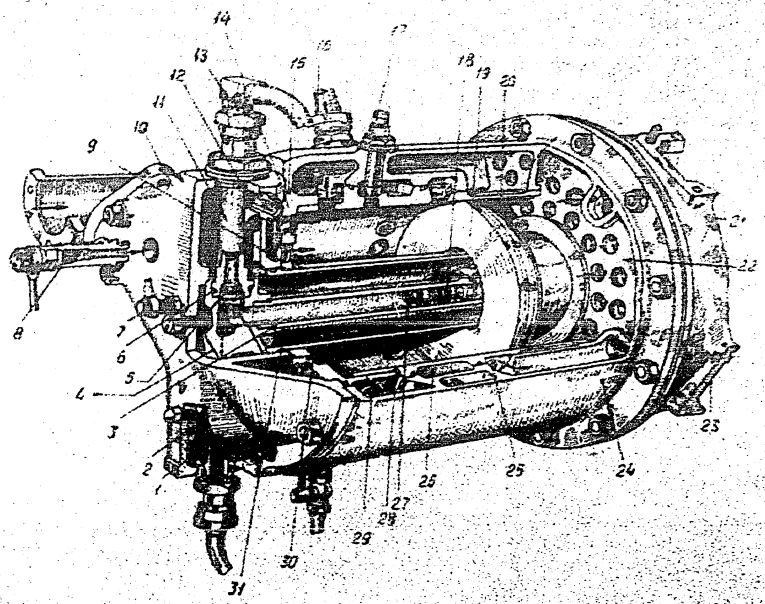

Fig. 3. 1st and 4th Stage Compressor Group

1 — 4th stage delivery pipe; *2* — protector; *3* — gasket; *4* — 4th stage head; *5* — 4th stage suction valve; *6* — gasket; *7* — oil pipe connector; *8* — non-return valve; *9* — 1st stage suction valve; *10* — 1st stage cover; *11* — suction pipe; *12* — cooling water outlet; *13* — air inlet; *14* — valve cover; *15* — gasket; *16* — cooling water inlet; *17* — oil pipe connector; *18* — 4th stage piston; *19* — 1st stage piston; *20* — 1st stage cylinder liner; *21* — intermediate casing; *22* — valve board; *23* — inspection ports; *24* — 1st stage casing; *25* — scavenging pump discharge valve; *26* — cooling water chamber; *27* — 4th stage cylinder liner; *28* — gasket; *29* — 1st stage discharge valves; *30* — safety screw; *31* — packing ring

the scavenging pump are fitted in the partition of the 1st stage near the connection flange. The air enters the intake space of the scavenging pump through a flanged pipe connection which is integral with the 1st stage casing.

The 1st and 4th stage cover *80* is fastened on studs to the 1st stage casing and is an iron casting with an integral cavity and a flanged pipe connection through which the air is drawn into

the 1st stage of compression. Pressed in the central part of the cover are head 79 with the 4th stage cylinder 95 and cast iron water jacket 54 of the 4th stage cylinder made water tight with rubber rings. Suction and discharge pipe connections 82 and 78, respectively, are screwed into the 4th stage cylinder head and lead through the water space of the cover. Rubber rings 81 are used for packing the pipe connections at the entry to the cover, and copper gaskets are employed inside the cover. Suction valve 80 and the discharge valve of the 4th stage are fitted in the respective pipe connections. A starting air connector is fitted through the cover at the end face and is provided with a non-return valve which is screwed into one of the seats for the 1st stage suction valves in the valve cover. A threaded opening is provided in the centre of the 1st and 4th stage cover which is closed with a plug and is used for pressing out the 4th stage cylinder with its head and water jacket.

The air spaces are made airtight with the use of copper gaskets 72, 302 and 306 that are squeezed tight when fastening the 1st and 4th stage cover to the 1st stage casing.

Cooling water is admitted to the water jackets on the 1st and 4th stage cylinders and to the water space in the cover of the same stages through connector 38 at the top of the 1st stage casing. The water is let out through a connector provided in the upper part of the 1st and 4th stage cover.

Cock 35 is provided at the bottom of the 1st stage casing for draining the cooling water.

Lubricant is fed to the 1st stage cylinder from the top through connector 73 projecting through the water jacket of the 1st stage casing, and is supplied to the 4th stage cylinder through a pipe passing the 1st and 4th stage cover and the water jacket of the 4th stage cylinder.

The silencer-filter is secured to the flanges of the 1st stage casing and the 1st and 4th stage cover.

2nd and 3rd Stage Compression Group

(See album sheets 10, 11, 31 and 32)

The 2nd and 3rd stage compression group consists of the following main parts: the 2nd—3rd stage casing with the 3rd stage cylinder, the 2nd stage cylinder liner and the 3rd stage cover.

The 2nd—3rd stage casing 85 is an iron casting of intricate outline provided with a flange by which it is secured to the engine casing with studs and bolts. Inside the casing there are mounted partitions separating the air and water spaces. An inspection port is provided in the casing and is closed with a cover. Pressed in the 2nd—3rd stage casing is the 2nd stage cylinder

liner *87* which in conjunction with the casing partitions form the water and air spaces sealed with rubber ring *86* and copper gaskets *90*, *305*. Lubrication connector *89* is turned in the top of

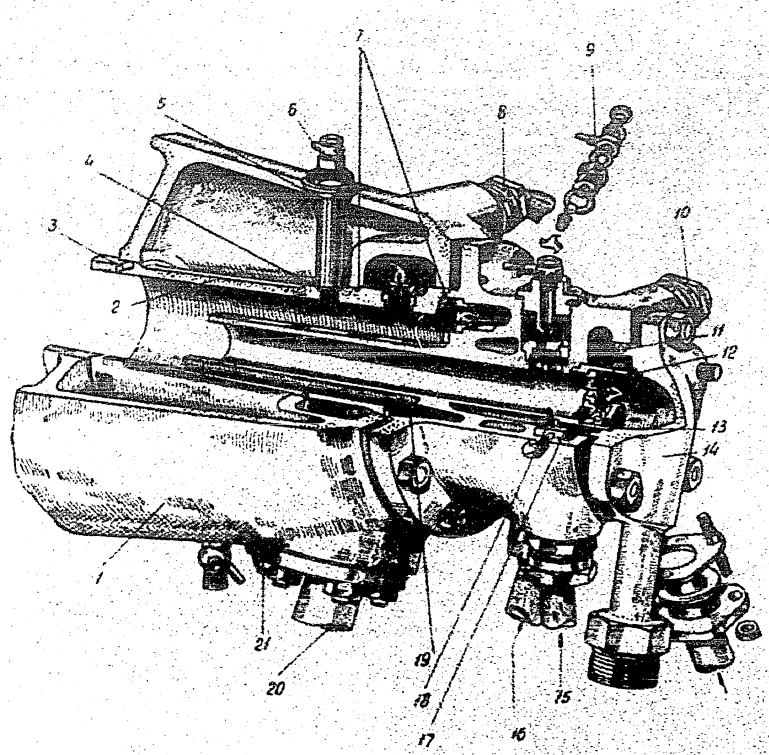

Fig. 4. 2nd and 3rd Stage Compressor Group

1 — 2nd and 3rd stage casing; *2* — 2nd stage cylinder liner; *3* — packing ring; *4* — gasket; *5* — packing ring; *6* — oil pipe connector; *7* — packing ring; *8* — cooling water outlet; *9* — starting air non-return valve; *10* — cooling water branch pipe; *11* — packing ring; *12* — gasket; *13* — valve ring; *14* — 3rd stage cover; *15* — water inlet; *16* — air inlet; *17* — protector; *18* — gasket; *19* — safety screw; *20* — air outlet from 2nd stage; *21* — protector

the 2nd stage cylinder through the water jacket. A water drain cock is provided in the water space at the bottom of the casing. Eight discharge valves *91* of the 2nd stage are arranged circumferentially at the outer end of the 2nd stage cylinder.

Group No.	Number of valves and place of installation	Valve assembly drg. No. and marking on valve cap	Part	
I	31 valves at 1st stage suction, 21 valves at scavenging pump suction and discharge, 8 valves in water pump	ДК2-06.007 Reference dia. Dy = 14 Marking 7	Valve cap ДК2-05.101	Valve seat ДК2-05.102
II	24 valves at 1st stage discharge, 17 valves at 2nd stage suction and discharge	ДК2-06.008 Reference dia. Dy = 14 Marking 8		
III	24 discharge valves of scavenging pump in 1st stage liner	ДК2-05.010A Reference dia. Dy = 12 Marking 10A	Valve cap ДК2-05.157	Valve seat ДК2-05.155
IV	5 valves at 3rd stage suction and discharge	ДК2-05.009A Reference dia. Dy = 12 Marking 9A		
V	1 valve at 4th stage discharge	ДК2-05.012 Reference dia. Dy = 10	Valve cap ДК2-05.135	Valve seat ДК2-05.136
VI	1 valve at 4th stage suction	ДК2-05.004A Reference dia. Dy = 10 Marking 4A	Valve cap ДК2-05.151	Valve seat ДК2-05.153

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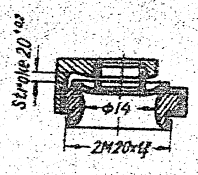
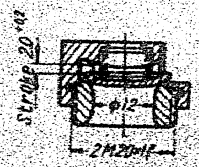
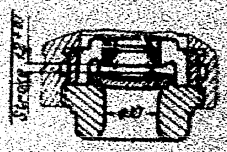
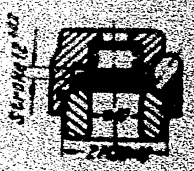
Table

drawing No.		Valve sketch
Disk ДК2-05.164 Thickness $\delta = 1$ mm Dia. 18 mm Height 3.3 mm	Spring 935-36.059 $Dia_{ext} = 9.6$ $d = 0.5$ $L_{loose} = 9$	
	Spring 935-36.006Б $Dia_{ext} = 9.6$ $d = 0.6$ $L_{loose} = 9.4$	
Disk ДК2-05.156 Thickness $\delta = 1.5$ mm Dia. 16.5 mm Height 3.1 mm	Spring 935-36.059 $Dia_{ext} = 9.6$ $d = 0.5$ $L_{loose} = 9$	
Disk ДК2-05.160 Thickness $\delta = 2$ mm Dia. 18 mm	Spring 935-36.006Б $Dia_{ext} = 9.6$ $d = 0.6$ $L_{loose} = 9.4$	
Disk ДК2-05.159 Thickness $\delta = 2$ mm Dia. 15 mm	Spring 935-36.060 $Dia_{ext} = 8.6$ $d = 0.7$ $L_{loose} = 11$	

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The 2nd—3rd stage head *102* made integral with the 3rd stage cylinder is stud-fastened to the 2nd—3rd stage casing. With its annular projection the 2nd—3rd stage head presses the 2nd stage cylinder liner to the 2nd—3rd stage casing through a copper gasket.

Nine suction valves *101* of the 2nd stage are fitted in the face of the 2nd—3rd stage head and two suction valves *95* of the 3rd stage are located diametrically and vertically in its central part. Screwed in above the upper suction valve of the 3rd stage is a connection of the lubricating pipe line through which the lubricant is admitted and carried with the induced air into the 3rd stage cylinder. The flange of the head has a hole which communicates with the space of the 2nd stage cylinder. Starting air non-return valve *310* is screwed-in at the entry of this hole.

The 3rd stage cover *100* is stud-fastened to the 2nd—3rd stage head. Valve ring *96* incorporating three discharge valves *95* of the 3rd stage is placed between the 3rd stage cover and the 2nd—3rd stage head and is sealed with copper gaskets *98* and *94*. The ring is washed with cooling water.

All the water and air spaces in the 2nd—3rd stage casing and head have corresponding inlet and outlet pipe connections.

6. SPHERICAL DISK VALVES

(See album sheets 12 and 31)

Provision is made for 172 self-acting spherical disk valves in the compressor cylinders, scavenging pump and water pump of Diesel-driven compressor (164 air valves and 8 water pump valves).

All the valves are similar in type, each consisting of four parts: valve seat *110*, spherical disk *109*, spring *108* and spring cap *107*.

Being similar in type, the valves differ somewhat in geometrical dimensions of parts and, according to parts size, can be classified in six groups.

Material of valve parts: disks and springs of all the valves are made of X18H10T stainless steel, except for the 4th stage discharge valve in which BT1-1 alloy is used; seats and caps are made of БрАМц 9-2 bronze.

All the valves have a lift of 2 to 2.2 mm with the exception of the 4th stage suction valve having a lift of 1.2 to 1.4 mm and the 4th stage discharge valve having a lift of 1.2 to 1.3 mm. Design features of the valves and their installation places are shown in Table given below (see pages 18—19).

7. 4th STAGE SAFETY VALVE

(See album sheet 20)

The 4th stage safety valve is installed on the air piping after the 4th stage air cooler and is intended to prevent the pressure in the last stage of the Diesel-driven compressor from rising above the maximum permissible value. The valve is adjusted at the Manufacturer's shops to operate at a pressure of 240 to 245 kg/sq. cm in the air piping.

The 4th stage safety valve functions to automatically stop the Diesel-driven compressor and thereby precludes any further increase in the air pressure. This particular feature of the valve design can be used for automatical stopping the Diesel-driven compressor as soon as a predetermined pressure in the consumer receivers is attained.

To assure this the 4th stage safety valve should be set for a pressure equal to that of desired in the consumer receivers plus pressure losses in the air piping from the Diesel-driven compressor to the consumer receivers (which may be a group of air bottles, for example) and, when so adjusted, it should be fastened with a seal.

To avoid breakdown the resetting of the safety valve is permitted to be undertaken only for pressures not exceeding 245 kg/sq. cm.

The design of the valve is as follows:

Valve body *207* made of brass is turned on steel seat *206* with a chrome-plated sealing surface. The body is fixed on the seat by means of cylindrical pin *217*.

Inside the body is placed a cylindrical brass valve in the bottom of which in the bore is pressed the packing insert *209* of the oil-resisting rubber. To enable the dismantling of the valve and the pressing out of the packing insert the valve is threaded M6 in its middle part.

The valve is pressed down to its seat by spring *212* whose load is transmitted through spherical disk *211* and stop *210*. The spring tension is adjusted with cup *213* turned on the body. The valve having been adjusted, the cup is fixed with screw *214* and is sealed.

If the pressure of air after the 4th stage rises above 240 to 245 kg/sq. cm, the valve opens: the major portion of air is let out to the atmosphere through three ports provided in the middle part of the valve body, while some portion of air rushes to underneath the piston of the fuel pump control rack via connector *216* and by way of pipe leading to the fuel pump and actuates the piston shifting the pump control rack to neutral position, so that the fuel supply is cut off and the diesel engine of the compressor stops.

8. PRESSURE MAINTAINING VALVE

(See album sheet 21).

In contrast to compressors operating from separate driving units the Diesel-driven free-piston compressor requires for its normal and stable operation that the pressure in the 4th stage be not less than 150 kg/sq. cm. To ensure this essential condition the Diesel-driven compressor of the version No. 1 is fitted with a pressure maintaining valve that is mounted after the 4th stage and is set for a pressure of 150 kg/sq. cm. Thanks to this valve the compressed air is admitted to the consumer's line only when the pressure in the 4th stage reaches not less than 150 kg/sq. cm.

If the Diesel-driven compressor is allowed to operate with the pressure in the 4th stage below 150 kg/sq. cm, the pistons may come to knock against the covers which may result in breakdown.

The design of the valve is as follows.

Guide sleeve *225* is screwed into steel body *223* and has a lift limiter turned on its top end. Stem *224* slides inside the guide sleeve, its ball-tipped taper end coming to rest on the working face of upper seat *221*.

Rubber cup *222* of special profile is used to pack the stem against air leakage. The upper end of the stem abuts against the bottom of the cup which has a shoulder to support working spring *228*.

Adjusting cup *226* is put on the spring and is turned on the valve body to vary the tension of the spring. A stop screw is provided in the lower part of the cup to fix the cup position after adjusting. The amount of the valve lift is adjustable by placing a copper gasket of proper thickness underneath sleeve *225*.

Fitted in the lower part of the valve body are upper seat *221* and lower seat *220* packed with copper gaskets and held tight in place with connector *218*. The connector incorporates a ball-type two-spring check valve preventing the return of the compressed air into the compressor from the consumer's line.

Provided in the middle part of the valve body is connector *230* communicated by way of a pipe with 4th stage valve mounted on bracket *7*. The valve is used to let the air out after stopping the Diesel-driven compressor or to take off compression when bringing the pistons into the starting position. The pressure maintaining valve is set for the pressure of 150 kg/sq. cm against the indication of the 4th stage pressure gauge during the first-time starting of the Diesel-driven compressor, and is then sealed.

When the air is being delivered to empty bottles, the pressure maintaining valve gives way to heavy throttling of air which is followed by an intensive decrease in the air temperature and, if continued, may result in the icing of the valve, causing disturbance in normal operation of the Diesel-driven compressor.

The icing of the valve takes place until the pressure in the air bottles approximates 50 to 60 kg/sq. cm and it ceases as soon as this pressure is attained. To prevent icing it is necessary to raise the pressure in the water-oil trap to 50 to 60 kg/sq. cm by means of the trap outlet valve and to maintain this pressure until the pressure of the compressed air in the air bottles attains the same value. When valveless water-oil traps are used on the compressor, a stop valve should be fitted after the water-oil trap (near it) to serve the same purpose.

9. PRESSURE AND TEMPERATURE REGULATOR

(See album sheets 1 and 22)

To provide for stable operation and starting of the Diesel-driven compressor at exhaust in the gas outlet with increased pulsing counter-pressure up to 0.3 ± 0.2 kg/sq. cm (exhaust into water), the Diesel-driven compressors, delivered according to the version No. 2, furnished with a pressure and temperature regulator installed after the 4th stage.

The pressure and temperature regulator is of combined design and operates semi-automatically. It is intended to perform two functions:

1. To ensure automatic maintaining of pressure in the 4th stage cylinder not less than 150 kg/sq. cm right after starting the Diesel-driven compressor and during its operation for a receiver of the consumer with initial pressure of 0 to 150 kg/sq. cm, and when tightening additionally the spring by means of a special device for maintaining the pressure of not less than 205 kg/sq. cm in the 4th stage cylinder.

2. To prevent the valve seat and air piping after the valve from getting frozen, when the Diesel-driven compressor is operated for a receiver of the consumer with air pressure of less than 120 kg/sq. cm with the regulator being adjusted for 150 kg/sq. cm or with air pressure of less than 190 kg/sq. cm with regulator being adjusted for 205 kg/sq. cm.

The combined regulator consists of two parts: a pressure regulator and a temperature regulator. All the units and components are mounted in a steel housing.

Design and Operation of Pressure Regulator

The air delivered by the compressor is fed into the main piping and the consumer receiver through a combined regulator built in the delivery piping after the cooler and the 4th stage safety valve. As a result of compression the air passes through the ring passage formed by the bottom end of rod *256* and seat *254*.

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The minimum pressure required in the 4th stage cylinder is assured by maintaining a constant pressure in the space above the regulator seat, when throttling air through the changeable ring passage between the rod and seat. The passage is opened automatically to the required value under the action of the difference of forces applied to the rod upwards.

From underneath the rod receives the force of air pressure delivered, and from above the pressure of spring *318* and receiver air pressure force acts on the top end of the rod. To the top end of the rod air is supplied through a hole in the seat and the central passage of the rod. The receiver air pressure to the bottom end of tappet *316* counteracts the spring force.

To maintain the minimum required pressure in the 4th stage cylinder the regulator is adjusted by initial tightening of spring *318* which transmits its force through sleeve *315* and tappet *316*. Spring compression is adjusted by turning sleeve *139*, and maximum lift of the rod is limited by pressure nut *140*. Rubber collars are used to provide for necessary sealing of the rod and tappet.

Additional compression of spring *318* required to maintain the pressure of 205 to 230 kg/sq. cm in the 4th stage is effected by plunger *141* placed in sleeve *139*. The space above the plunger is communicated with the delivery chamber of the compressor 2nd stage by means of a pipe which is furnished with stop valve *321*.

With the stop valve opened compressed air from the 2nd stage is supplied to the space above the plunger and pressed against the plunger which moves downwards and supplies additional compression to the spring.

With the stop valve closed and discharge cock *322* opened air from the above plunger space is released, the plunger comes back to its top position, and spring *318* appears to be compressed to the initial value.

The plunger stroke is controlled by adjusting nut *142*.

In the bottom of the regulator body provision is made for a non-return ball valve which prevents air to flow from the main piping back to the 4th stage, when the Diesel-driven compressor is out of operation.

The non-return valve consists of upper *198* and lower *247* seats, ball *253*, and two springs *249* and *251* placed in the union connector.

Design and Operation of Temperature Regulator

When throttling cooled air through ring passage of the pressure regulator to the consumer's receiver, icing of the seat and pipeline takes place.

To eliminate icing provision is made for temperature valve *196* in the regulator design. The valve is pressed against the seat by

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means of spring *185*. Two cavities are formed inside the regulator body by the valve disk: lower one under the valve disk and upper one above the valve disk.

During the Diesel-driven compressor operation the lower cavity is filled with cooled air, and the upper one with hot air which is taken off before the 4th stage cooler and admitted into body *145* through connector "T" the pass valve of which is adjusted by hand with the help of throttling screw *319*. The position of the adjusting screw is fixed by locator *320* through every 1/6 of the screw turn.

Icing of the seat is eliminated by letting hot air flow from upper cavity to the lower one and by mixing the hot air with the cooled air in the lower cavity. This air by-passing is effected automatically under the action of the force difference, which is variable in valve and in direction, upon the valve.

The following forces act upon the valve disk: pressure force of air delivered from the 4th stage acting from below, and pressure forces of the same air plus tension of spring *185* and pressure of air filling the consumer's receivers acting upon the top end of the valve.

The presence of forces acting upon the valve in opposite directions provides for obtaining the difference of forces which can vary in value and direction.

In case of setting the regulator for maintaining 150 kg/sq. cm in the 4th stage, the force difference is created by the tension of spring *185* so as when the pressure in the consumer's receiver ranges from 0 to 120 kg/sq.cm, the regulator acts upwards. In this case the valve is raised and the cavities of cooled and hot air are communicated. The warming of air takes place. When pressure in the consumer's receiver comes up to 120 kg/sq. cm and above, the difference of forces changes its direction, that is acts downwards. The valve closes and the cavities become disconnected.

If the regulator is set for maintaining pressure of 205 kg/sq.cm in the 4th stage, the force difference changes its direction and closes the valve when the pressure in the consumer's receiver reaches 190 kg/sq. cm.

The proper operation of the temperature regulator is determined by touching the regulator body, if the body is hot, it means that the hot air flow into the lower cavity takes place.

B. SYSTEMS

1. FUEL INJECTION SYSTEM

(See album sheets 13 and 15).

The fuel injection system consists of a fuel injection pump, a high pressure piping and a fuel injection nozzle.

The fuel injection pump consists of float chamber *130*, pump head *120*, pump drive and pump casing *113*.

The pump casing accomodates: hand-priming lever *125*, toothed rack *123* and tappet arm *114*.

Plunger barrel *119* is fitted in the pump head with a discharge valve *121* being pressed to the top of the barrel.

Float chamber *130* is provided with filter *313* and float *312* to maintain the fuel level in it.

Air bubbles suspended in the fuel are separated from it in the float chamber.

The cleaned fuel flows from the float chamber to the suction chamber through an inclined passage drilled in the pump head.

Specially selected and accurately ground plunger *118* enters the plunger barrel. Pressed on the plunger head is gear *116* meshing with toothed rack *123*.

The plunger barrel has two rows of ports in it. The upper ports are intended for suction and let the fuel in the space above the plunger while the lower ones are intended to cut off fuel injection.

The plunger has two skew cuts at its top end. An axial passage is drilled in the plunger and is crossed by a radial one to communicate the space above the plunger with an annular groove provided in the middle part of the plunger.

The plunger is moved downward (suction stroke) by recoil spring *117* and is driven upward (discharge stroke) by means of cam *112*.

As the plunger comes on its discharge stroke to cover the suction ports in the barrel, the pressure of the fuel in the barrel rises rapidly, the discharge valve opens and the fuel is forced through the high pressure pipe and nozzle into the engine cylinder.

The fuel injection continues until the plunger annular groove registers with the lower ports in the barrel at which moment the fuel begins to escape from the space above the plunger to the suction chamber through the by-pass ports, the discharge valve closes cutting off fuel supply.

The quantity of fuel delivered by the pump is variable by turning the plunger and thereby changing the fuel injection starting moment.

The plunger is rotated by the toothed rack that is in mesh with the plunger gear.

As toothed rack *123* is shifted to the left, the quantity of fuel delivered is increased. The receding of the rack to the right decreases the fuel charge. The fuel delivery is completely cut off when the rack comes to its extreme right-hand position in which the suction ports of barrel *119* remain closed for the whole suction stroke of the plunger and the fuel is not admitted into the

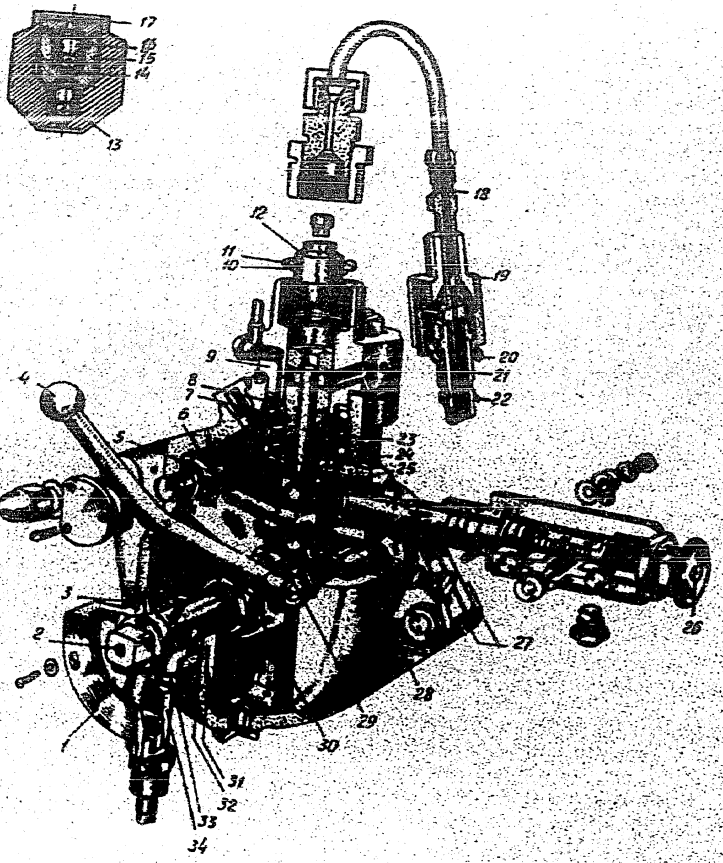

Fig. 5. Fuel Pump

1 — stroke index scale; *2* — transmission shaft; *3* — stroke index; *4* — handle; *5* — tappet; *6* — tappet arm; *7* — recoil spring; *8* — packing ring; *9* — fuel pump head; *10* — packing ring; *11* — washer; *12* — discharge valve; *13* — valve body; *14* — valve; *15* — valve seat; *16* — valve spring; *17* — locking ring; *18* — knife-edge filter rod; *19* — nozzle body head; *20* — packing ring; *21* — nozzle body; *22* — packing ring; *23* — plunger; *24* — spring disk; *25* — gear; *26* — toothed rack; *27* — gasket; *28* — fuel pump casing; *29* — needle bearing; *30* — cam washer; *31* — thrust flange; *32* — packing ring; *33* — gasket; *34* — stroke index scale flange

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space above the plunger. In this position the mark on the plunger ends *118* should register with that on the barrel *119*.

The right side of the rack has angle teeth in it. The detent comes in between the rack teeth under the action of the spring and thereby fixes the position of the rack. Being in position ensuring the operation of the Diesel-driven compressor at maximum load, the toothed rack is fixed by hollow screw *124*, in addition to being fixed with the detent. This position of the rack is conventionally called "0" position to which the rack is brought at starting the Diesel-driven compressor.

During operation it is not recommended to have the compressor running at "0" position as in this case the Diesel-driven compressor is overloaded. The routine operation of the Diesel-driven compressor is maintained with rack *123* being shifted by one tooth from "0" position in the direction of decreasing the fuel charge, i. e. to "1" position. It is also possible to run the Diesel-driven compressor with the rack shifted by 2 teeth more, these being called positions "2" and "3" respectively. When the rack is in "3" position, the fuel charge is reduced to 60% of the maximum.

The middle part of the rack is made in the form of a piston that slides in sleeve *122*. The sleeve has an annular groove that is pipe-communicated with the safety valve of the 4th stage. Should the air pressure after the 4th stage increase above 240 to 245 kg/sq. cm, the safety valve opens and by-passes some part of the air into the annular groove in sleeve *122* which makes the rack recede to the right, cutting off the fuel supply and thereby stopping the Diesel-driven compressor automatically.

Before starting the Diesel-driven compressor the high pressure piping and nozzle should be filled with fuel. This is accomplished by means of hand-priming lever *125*.

When hand-priming lever *125* is lifted, tappet arm *114* is brought out of the contact with the cam which results in termination of the fuel delivery, thus enabling the stopping of the Diesel-driven compressor by hand.

Fuel Injection Nozzle (See album sheet 14). The fuel injection nozzle is intended to atomize the fuel fed into the power cylinder by the fuel injection pump.

The Diesel-driven compressor is fitted with an open type nozzle of the following design:

Nozzle spray *133* is fitted into body *132* and has nozzle needle *137* in it. A knife-edge filter is pressed to the top end of the nozzle needle. All the parts of the fuel injection nozzle are tightly held together by means of body head *138* and thrust sleeve *134*.

The fuel is forced by the fuel injection pump through the knife-edge filter consisting of body *136* and four-slit rod *135* and enters the axial passage drilled in the nozzle needle. The axial

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drilled passage terminates in two inclined tunnels 0.35 mm in diameter which take the fuel to two 0.3 mm wide grooves that are cut generatrixwise in the nozzle needle cone. Through these grooves the fuel leaves the nozzle at high velocity in two opposed jets spreading into the combustion chamber of the engine in the form of atomized fan-shaped cone spray of ellipsoidal section. The major axis of the spray ellipse is parallel to the piston heads.

2. LUBRICATION SYSTEM

(See album sheets 29, 30, 31 and 32)

The lubrication system of the Diesel-driven compressor consists of a lubricator and piping system to carry lubricating oil to the machine lubrication points.

The lubricator is driven by reciprocating drive rod *160*.

Lubricator drive rod *160* is pivot-connected to rocker *298* the other end of which is secured to the casing of roller coupling *294*.

With drive rod *160* moving up, roller coupling casing *294* performs a slight turn clockwise (when looking at it from the side of the handwheel fastened on horizontal shaft *292*) and wedges rollers *301* between casing *294* and sprocket *300* so that the casing gets rigidly connected with the sprocket providing for rotation of shaft *292*.

As the drive rod goes down, the roller coupling casing *294* returns to initial position, releasing the rollers and thereby interrupting the motion of the lubricator shaft, i. e. its feed rotary action.

To prevent shaft *292* from turning back on the receding stroke of the drive rod, another roller device is provided. This roller device consists of casing *293* fastened on the lubricator body, a few rollers and sprocket *299*. The device operates in the following manner.

When shaft *292* turns counter-clockwise, the key-fixed sprocket *299* turns together with the shaft. The rollers get wedged between sprocket *299* and casing *293*, tending to rotate the latter which however results in an abrupt stop of sprocket *299*, and hence, of shaft *292* since casing *293* is rigidly fastened on the lubricator body. In this manner the roller coupling acts to convert the reciprocating motion of drive rod *160* into intermittent rotary motion of shaft *292*.

The lubricator is a ten-plunger vertical pump with slide valve distribution.

Plungers *296* and slide valves *297* are ground individually to the bodies of pump elements *286* and are fitted therein. The bodies of pump elements *286* are arranged around vertical shaft *292*.

Inclined disk *287* actuating the slide valves is keyed rigidly on shaft *290* and with its shoulder engages profile disk *288* that actuates the plungers.

A helical drive gear fixed on shaft *292*, transmits motion to driven gear *289* fitted on shaft *290*. Shaft *290* imparts rotary motion to slide-valve actuating disk *287* and plunger actuating disk *288* which throw plungers *296* and slide valves *297* in reciprocating motion. The working cycle of each pump element is performed as follows.

The suction stroke is accomplished by plunger *296* when it is pushed up. The oil is sucked through a strainer and is admitted into the space underneath the plunger via a drilled passage in the body of pump element *286* and a passage drilled radially in slide valve *297* which moves down. The suction stroke is terminated when tappet screw *295* comes on the horizontal section of plunger actuating disk *288*. Slide valve *297* proceeding its downward movement first communicates the space underneath the plunger with the lower horizontal passage drilled in the pump element body and then covers it.

As the plunger proceeds from the horizontal to the descending section of profile disk *288* it starts to move on its discharge stroke during which the lubricating oil is forced from underneath the plunger through a longitudinal groove in slide valve *297* and a drilled passage in the body and is thence carried to the corresponding lubricated point of the Diesel-driven compressor by way of a pipe. The discharge stroke of plunger *296* is completed when the plunger comes off the descending section of the profile of plunger actuating disk *288* to its horizontal section.

The quantity of oil delivered per a single stroke of the plunger is adjustable by means of tappet screw *295*. The tappet screw is of a left-hand thread and is turned into the upper part of the plunger frame. Four longitudinal grooves equally spaced on the tappet screw are milled axially on its circumference. A flat spring fixed on the plunger frame presses a detent to the side surface of screw *295*. The detent enters the longitudinal groove in tappet screw *295* and prevents it from occasional turning.

The turning out of tappet screw *295* increases the clearance between the lower head of the screw and plunger actuating disk *288* and decreases the plunger stroke thus reducing quantity of oil delivered.

In one turn of screw *295* the detent leaves and enters the longitudinal grooves in screw *295* four times with a characteristic click following each entry. The adjustment of the oil charge to the lubrication points is performed according to the number of clicks produced while turning screws *295* from the lowest position.

The lubricator is delivered from the Manufacturer with its driving shaft designed for a speed of 3 to 5.5 r. p. m., the oil charge to the individual points being adjusted to match this speed. In routine operation of the Diesel-driven compressor the

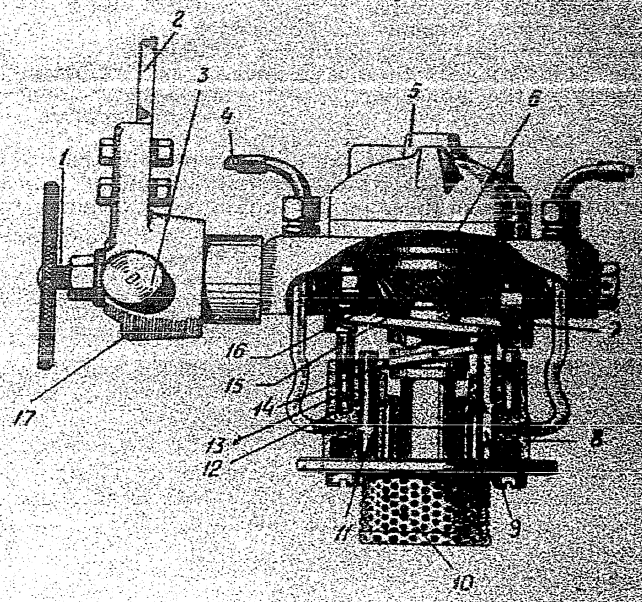

Fig. 6. Lubricator

1 — shaft; *2* — rocker arm; *3* — cap oiler; *4* — oil outlet; *5* — cover; *6* — filter; *7* — screw; *8* — body; *9* — slide valve; *10* — filter; *11* — slide valve; *12* — delivery chamber; *13* — operating plunger; *14* — slide valve actuating disk; *15* — plunger actuating disk; *16* — driven gear; *17* — coupling

speed of the lubricator driving shaft tends to increase and is likely to reach 6 to 7 r. p. m. after 500 to 1000 operating hours. This necessitates that with the increase in its driving shaft speed the lubricator be adjusted according to the Table given below to maintain the correct supply of lubricating oil.

The given table provides a tentative scheme for the regulation of the oil charge to be corrected during the operation of the machine from observation of heating at the lubrication points. Heating at individual lubrication points is a sign of inadequate lubrication, which is eliminated by increasing oil charge to the said points.

When adjusting the lubricator it is necessary to check those pump elements which have their tappet screws turned-in for 16 or 17 clicks. The check is to be made by turning the handwheel of the lubricator while keeping a watch on the end of the pipe disconnected from the respective lubrication point; with the said adjustment the pump element should deliver 5 to 7 drops every four revolutions of the driving shaft, the revolutions and drops to be counted beginning with the appearance of the first drop.

The r. p. m. of the lubricator driving shaft is determined when the compressor operates with maximum fuel consumption and at a pressure of 230 kg/sq. cm after the 4th stage.

Besides, by all means, check the oil feed to points Nos. 5 and 8 applying a measuring glass at 60 revolutions of the lubricator shaft. The oil delivery to these points should be as follows:

point No. 5 . . . . . 4.5—5.5 cu. cm
point No. 8 . . . . . 2—3 cu. cm

The check is to be carried out with a shut-down compressor by turning the lubricator handwheel manually.

Lubricating oil from the pump elements is delivered by pipes to different lubrication points on the machine. The Diesel-driven compressor has 10 lubrication points which are shown in the lubrication chart and specified in the table below.

Lubricator Tappet Screw Adjustment Table

No. of lubrication point — place of lubrication	Number of clicks at various lubricator drive shaft speed, r. p. m.										
	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
1 — tooth rack guide (water pump side)	4	6	7	8	10	11	11	12	12	13	13
2 — water pump drive shaft	9	10	12	14	15	16	16	16	16	16	16
3 — 3rd stage cylinder	0	0	0	0	0	0	1	2	3	4	5
4 — 2nd stage cylinder	0	0	1	2	3	4	5	5	6	6	7
5 — engine liner (exhaust side)	2	3	4	5	6	7	8	9	9	9	9
6 — tooth rack guide (fuel pump side)	4	6	7	8	10	11	11	12	12	13	13
7 — fuel pump shaft	10	11	13	15	16	17	17	17	17	17	17
8 — engine liner (scavenging side)	11	12	14	16	17	17	17	17	17	17	17
9 — 1st stage cylinder	3	4	5	6	7	8	9	10	11	12	12
10 — 4th stage cylinder	0	0	0	0	0	0	1	2	3	4	5

3. COOLING SYSTEM

(See album sheets 16, 17, 18 and 19)

The cooling system comprises: the water pump, cylinder and cover water jackets, four interstage coolers, water piping and a sight glass.

The water pump draws water from the water supply mains and delivers it into the 2nd stage cooler. The further route of the cooling water is shown in the diagram of the Diesel-driven compressor. After the 1st stage cooler the water is carried away by a pipe that has a sight glass in it for observation of the water flow.

Should intensive bubbling be seen through the sight glass, it is a sign that the sealings between the air and water spaces are faulty.

A satisfactory cooling of the Diesel-driven compressor is ensured by circulation of water through its cooling system in the volume of 1.6 to 2.2 cu. m/hr which is within the normal delivery of the water pump.

The hydraulic resistance of the ДК2 cooling system proper against which the water pump ensures an adequate cooling of the Diesel-driven compressor is 1.2 to 1.3 kg/sq. cm.

An increase in the hydraulic resistance of the cooling system is liable to reduce the delivery of the water pump which will unavoidably result in inadequacy of cooling, especially in summer months. Therefore it is desirable that no additional hydraulic resistances be connected into the ДК2 cooling system when installing the Diesel-driven compressor on site. In case of extreme necessity to do so one should bear in mind that the pressure of water measured directly after the water pump should never exceed 1.6 kg/sq. cm.

If the water pump is installed above the drawn-in water level, its suction piping should be provided with a non-return valve close to the said level to enable the priming of the water pump before starting. The suction head is not to be more than two metres.

For the case of the pump failure provision should be made for cooling the ДК2 compressor from an outside main at a pressure of 1.5 to 2 kg/sq. cm.

If a permanent water main with a pressure of 1.5 to 2 kg/sq. cm is available, the cooling of the Diesel-driven compressor can be carried out from this main alone, by letting the water directly into the 2nd stage cooler. In these cases the water pump should be removed from the machine.

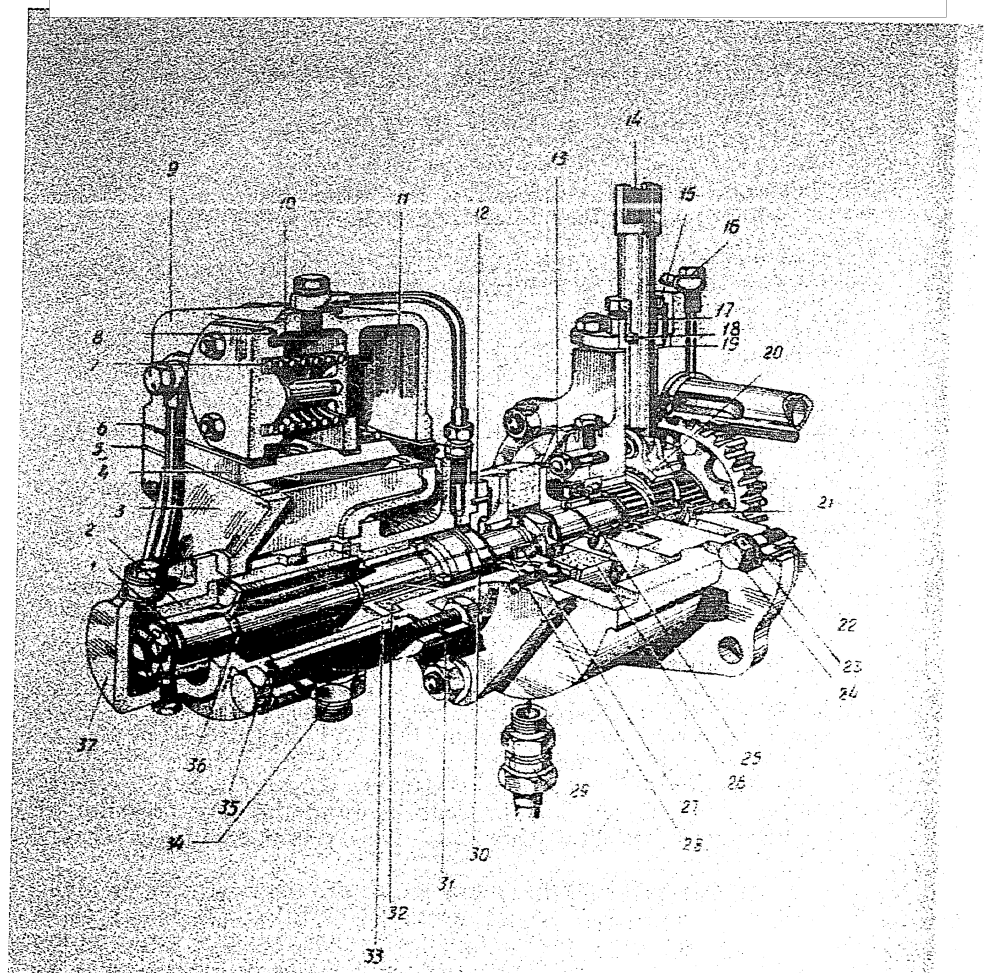

Fig. 7. Water Pump with Drive

1 — shaft sleeve; *2* — bearing bush; *3* — pump casing; *4* — valve board; *5* — gasket; *6* — gasket; *7* — gasket; *8* — gasket; *9* — water pump head; *10* — suction chamber; *11* — delivery chamber; *12* — gasket; *13* — adjusting pointer; *14* — drive rod; *15* — pressure nut; *16* — pipe connector; *17* — guide bush; *18* — packing; *19* — gasket; *20* — shackle; *21* — hole for pin setting; *22* — drive cover; *23* — gasket; *24* — bolt; *25* — distance bushe; *26* — coupling; *27* — cone sleeve; *28* — washer; *29* — drain pipe; *30* — packing gland housing; *31* — gasket; *32* — bearing bush; *33* — sleeve with partition; *34* — pipe connection; *35* — gasket; *36* — pump shaft; *37* — bearing cup

SECRET

Water Pump with Drive

(See album sheets 16 and 17)

The water pump is of the following construction. Fitted in the cast bronze casing of pump *146* is bronze sleeve *147* with an internal vertical longitudinal partition in its upper part and four ports located on either side of the partition. At one end the pump casing is closed with bearing cap *150* and at the other end — with packing gland housing *165*, fluorine plastics bushes *166* and *148* being fitted in them. The fluorine plastics bushes are the bearings of pump shaft *156*.

The middle portion of the pump shaft rotating in sleeve *147* is fitted with a blade and has bronze sleeves *149* and *167* pressed on it on either side of the blade which act as the shaft carrying journals. Thus, the sleeve partition and the rotating blade of the shaft divide the sleeve into two spaces variable in volume that are communicated by ports with the cavities in the pump casing and form the pump displacement spaces.

Valve board *152* with four discharge valves and four suction disk valves *155* is placed between the pump head *153* and the casing, each working space being thus provided with two suction and two discharge valves. The pump head is divided by a partition in two spaces: suction and discharge ones. The partition incorporates a safety valve set for a pressure of 2 kg/sq. cm.

Pump shaft *156* is sealed with a special packing gland closed in housing *165*. The packing gland consists of carrier *176*, packing gland housing *173*, rubber ring *174* and ebonite ring *172*. The rubber ring is used to secure tightness about the shaft and the ebonite one at the shaft end. Carrier *176* and the packing gland housing are forced apart by conic spring *175* and rotate together with the pump shaft. The driven end of the pump shaft has coupling flange *157* secured to it by means of slit cone sleeve *158* and a nut; the flange engages coupling *159*, thereby connecting the shaft to pump drive flange *163*.

The water pump operates in the following manner. Water from the supply main enters the suction chamber in the water pump head and thence gets to the pump spaces through the suction valves. When the Diesel-driven compressor is running, alternating rotary motion from the synchronizing mechanism racks is imparted to the drive gear, the angle of the gear turn being somewhat lesser than complete revolution. This motion is transmitted to the pump shaft through the medium of the drive shaft, flange and coupling. With its side facing the direction of rotation the pump shaft blade forces water through the discharge valves to the discharge chamber and then into the piping. Simultaneously, water is drawn in at the back of the blade from the suction chamber of the pump head. Thus, every double stroke of the

Diesel-driven compressor pistons brings two cycles of water suction and two cycles of water discharge.

The fluorine plastic bearings are cooled with water penetrating through the clearances between the shaft bronze bushes and between the casing sleeve and the partition. The water accumulated in the internal cavities of bearing cap *150* and packing gland housing *165* is drawn back into the suction chamber through pipes *151* and *154*.

The water pump drive consists of drive cover *162* and drive casing *164*. Mounted on one ball and two needle bearings inside the drive cover and casing is eccentric drive shaft *161* with gear *127* of the synchronizing mechanism. An ear ring is fitted on the needle bearing and is pivot-jointed to lubricator drive rod *160* reciprocating in a cast iron sleeve. Cone sleeve *158* and the nut are used to secure coupling flange *163* at the end of drive shaft *161*. The flange has two shoulders. Identical flange *157* is provided at the end of the pump shaft. Slotted textolite coupling *159* is inserted between the two flanges to transmit motion and to cushion shocks at the reversal of rotation.

Leakage of oil along drive shaft *161* is prevented by rubber packing *170* permanently compressed by ring spring *169*. The water pump is stud-fastened to the drive casing *164*.

Coolers

(See album sheets 18 and 19)

For the number of its compression stages the ДК2 Diesel-driven compressor has four water-cooled air coolers suspended to the bottom of the compressor frame. The object of the coolers is to cool compressed air after the respective compression stages. All the four coolers employ the principle of water and air counterflow to enhance the transfer of heat from air to water.

The 1st stage cooler consists of welded steel housing *179* that houses radiator *181* which is a copper tube with brass ribs soldered to it. Water flows inside the radiator tube while the air forced from the 1st stage cylinder streamlines the radiator.

A safety valve set for a pressure of 7 kg/sq. cm is mounted on the 1st stage cooler housing.

The coolers of the 2nd, 3rd and 4th stages consist of housing *192*, *195* and *204* respectively, each housing incorporating tube sections. The air flows inside the tubes while the water washes the tubes on passing through the housings.

Blow-through valves are mounted on bracket 7 for the drainage of oil and condensate from the coolers of the 1st, 2nd and 4th stages.

4. EXHAUST SYSTEM

The Diesel-driven compressor is equipped with a single-cylinder two-cycle free-piston engine sensitive to variations in exhaust conditions; therefore its normal performance is guaranteed only provided the following requirements are observed with respect to the exhaust system:

a) the exhaust system should be provided with the silencer which is supplied therewith;

b) the exhaust pipe from the Diesel-driven compressor to the silencer is to be within 1.5 to 2.5 metres in length;

c) the static exhaust back pressure should not be higher than 50 mm Hg with an individual exhaust arrangement and at normal suction resistance.

Failure to comply with the requirement concerning the length of the exhaust pipe results in reduction in the compressor output and makes the starting of the compressor difficult.

The Diesel-driven compressor can show stable operation even at an increased exhaust resistance, though not exceeding 250 mm Hg (with an individual exhaust arrangement), but in this case the working processes in the engine cylinder become worse in quality, which brings about reduction in output and rise of exhaust temperature.

With the exhaust resistance of 250 mm Hg the temperature of exhaust gases is 520° C and the compressor gives an output of about 7.0 l/min.

When the Diesel-driven compressor and the main engine operate simultaneously on the common exhaust system, it is necessary to remember:

a) at certain duties of the main engines, especially at full output, unfavourable wave occurrences may take place in the common exhaust piping; this could affect the working processes in the ДК2 engine, bringing about instability of operation or spontaneous shut-down of the compressor at these duties;

b) the Diesel-driven compressor should be started only with the ДК2 exhaust piping disconnected from the common exhaust piping.

In case of installation of a pressure and temperature regulator adjusted for maintaining 205 kg/sq. cm the Diesel-driven compressor can operate steadily even with increased counter-pressure on the exhaust with pulsations created by sea wave and rarefaction on the suction. The amount of counter-pressure on the exhaust and rarefaction on the suction is determined in each case by testing the Diesel-driven compressor. During this test are specified the output of the compressor and temperature of exhaust gases.

SECRET

Silencer (See album sheet 23). The silencer is of a welded construction and is made of low-carbon sheet steel. Silencer body *232* consists of inner flanged pipe *235* heat and noise insulated with slag wool coating *234* and protected from outside by pipe *233*.

Fitted in the silencer body at the side of the gas inlet is flame trap housing *231* and at the side of the gas outlet is a set of expanders *236*. Drain cock *238* is provided at the bottom of the silencer body for draining condensate or water happened to get to the inside.

5. AIR SILENCER-FILTER

(See album sheet 24)

Air silencer-filter *19* is fastened to the 1st—4th stage cover and the 1st stage casing; it is intended for cleaning the inlet air and reducing the noise of suction.

6. STARTING SYSTEM

(See album sheets 25, 26 and 27)

The Diesel-driven compressor is started with air compressed to a pressure of 26 to 30 kg/sq.cm. The air pressure drop in the starting air bottle to the said value is obtained through the medium of a reducing valve provided between the starting air bottle and the compressor.

The starting system comprises: a hand-actuated starting valve, self-acting starting mechanism, non-return valves of the 1st and 2nd stages and piping.

Hand-Actuated Starting Valve

The hand-actuated starting valve is used for delivery of compressed air to the Diesel-driven compressor starting system. The valve consists of body *244* to which three valves are thread connected. One of them serves to supply air into body *244* and into the piping for filling the 2nd, 3rd and 4th stages of the compressor. This valve is opened by pressing handle *250* fitted on shaft *248*. When the pressure in body *244* reaches 16 to 18 kg/sq.cm, opens the second valve *260* (regulating one) through which the 1st stage cylinder is filled up. The third valve *246* is safety one and adjusted for 26.5 ± 1 kg/sq.cm.

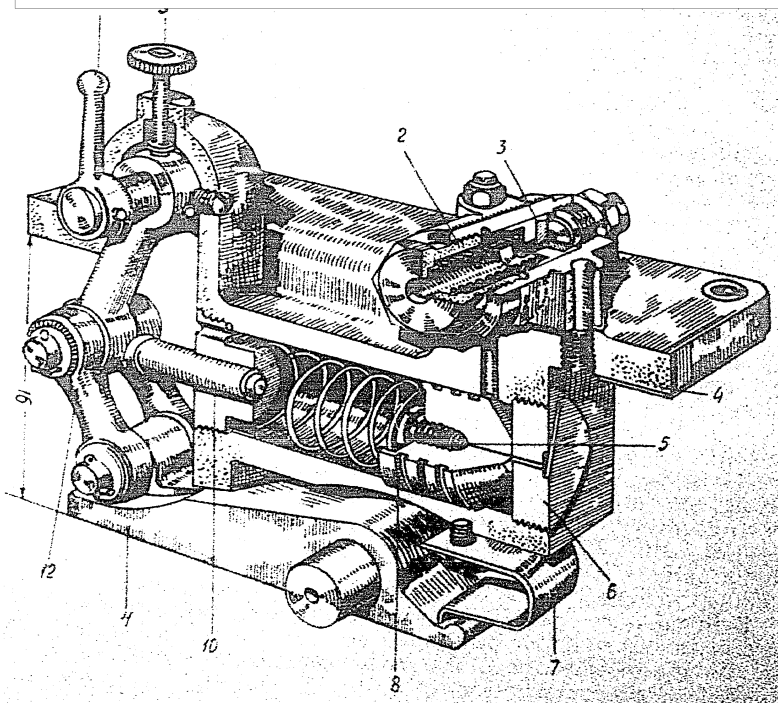

Fig. 8. Self-Acting Starting Mechanism

1 — lever; *2* — self-acting starting mechanism; *3* — piston; *4* — body; *5* — bolt; *6* — plug; *7* — spring; *8* — percussion piston; *9* — locator; *10* — pin; *11* — starting latch; *12* — lever

Self-Acting Starting Mechanism

The self-acting starting mechanism consists of a self-acting starting valve and starting mechanism proper. The self-acting starting valve is intended to admit the starting air into the cylinder of the starting mechanism.

The cylinder of the starting mechanism is bored in the mechanism body. Fitted in the cylinder are percussion piston *269*, spring *265* and pin *264*.

Starting latch *271* is pivoted with its one end on axle *270* in the lower part of the starting mechanism body. The other end of the latch is connected with a two-member link secured in the

upper part of the starting mechanism body. After starting the latch is retained in its upper position by spring *268* and stop *262* entering a conical recess in the head of lever *263*.

Starting the Diesel-Driven Compressor

Starting the Diesel-driven compressor is effected as follows: The piston groups are brought apart by starting handle *275* as far as they go, then stop *262* is lifted and lever *272* is turned to the left while the two-member link forces the starting latch down. Then the pistons are brought together by starting handle *275* until the pin of the cross-member at the scavenging side rests against the starting latch.

By depressing the hand-actuated starting valve lever the air is delivered to body *244* wherefrom it rushes to the 2nd, 3rd and 4th stages of the compressor. When the pressure in the 2nd, 3rd and 4th stages rises to about 16 to 18 kg/sq. cm the regulating valve *260* opens and initiates the filling of the 1st stage, the process of filling the other stages being continued simultaneously. As soon as the air pressure reaches 4 to 6 kg/sq. cm in the 1st stage and 24 to 26 kg/sq. cm in the other stages, the self-acting starting valve *267* admits the air to the cylinder of the starting mechanism. Under the action of the air pressure the percussion piston *269* moves and strikes against pin *264* that abuts on the middle joint of the two-member link, the latter collapses, making starting latch *271* disengage the cross-member pin.

Being thus released, the pistons move together under the pressure of the starting air and compress the air in the engine cylinder. As the pistons reach the inner dead centre position, fuel is injected into the cylinder and ignites at the high temperature of the compressed air.

7. SYSTEM FOR TAKING AIR FROM THE 1st STAGE FOR SCAVENGING

(See album sheets 1, 2, 3 and 28)

In order to ensure a better working process in the Diesel engine and to reduce carbonization at the exhaust ports and on the engine pistons provision is made in the compressor for taking air from the 1st stage to the scavenging air receiver. The air is taken through a self-acting valve mounted on the hatch cover and by way of piping. When starting, the valve automatically shuts the piping between the 1st stage and the scavenging air receiver and does not let the air from the 1st stage to the receiver. After the compressor has been started and the air escapes from the starting air piping, the spring and the air pressure in the 1st stage force the piston with rubber insert *93* off its seat and the air rushes

from the 1st stage to the scavenging air receiver through a drilled passage in the seat and an orifice.

The cross section of the orifice is chosen so as to secure the optimum conditions for air taking.

Besides reduction in carbonization and increase in the term of service between overhauls, this arrangement for additional air taking substantially helps to improve the operation of the ДК2 set under "Schnörchel" conditions.

C. CONTROL INSTRUMENTS

The instrument board carries four pressure gauges for measuring the air pressure in the stages when starting and during operation of the Diesel-driven compressor.

III. INSTRUCTIONS FOR OPERATION

THE ATTENDANT MAY BE ALLOWED TO OPERATE THE COMPRESSOR ONLY AFTER HE HAS THOROUGHLY STUDIED THE "DESCRIPTION AND INSTRUCTIONS FOR OPERATION OF TYPE ДК2 DIESEL-DRIVEN COMPRESSOR".

Important!

It is strictly forbidden to add petrol to Diesel fuel when starting or during operation.

The compressor should be started only with compressed air.

Compressed air used for starting the Diesel-driven compressor should always be free from moisture.

If water is carried with starting air into the compressor cylinders, it would cause corrosion resulting in rapid wear of parts or even ultimate breakdown.

The following precautions should be taken to make sure that the starting air is free from moisture:

a) a water-oil trap should be fitted in the air piping after the compressor;

b) the entire starting system of the ДК2 compressor should, by all means, be blown through immediately before starting.

Upon removal of slushing compound and before starting the compressor, care should be taken to check the tightness of the compressor packings, for which purpose proceed as follows:

a) fill the water spaces with water and close the valve at the water inlet into the compressor;

b) using the hand-actuated starting valve, admit the starting air to the compressor cylinders, and watching the pressure gauge indications, see that the pressures in the stages are within the following ranges: the 1st stage from 2.5 to 3 kg/sq. cm, the 2nd and 3rd stages from 24 to 26 kg/sq. cm (if the pressures are allowed to exceed the above limits, the Diesel-driven compressor may start running);

c) after the compressor cylinders have been filled with air, check the condition of water through the sight glass. Any bubbling observed through the glass is a sign of air leakage from the compressor cylinders into the cooling water.

The most likely cause of air leakage is the insufficient tightness of the lubrication connectors in the 1st and 2nd compressor

stages. In this case for the elimination of the air leakage it is necessary to drain the water and to thoroughly tighten the connectors, replacing the copper gaskets underneath them, if required.

The above described check should be carried out not less than once a week.

A. PREPARATIONS FOR STARTING

1. Fill the fuel tank with filtered fuel.
2. Fill the lubricator with filtered oil until the oil level indicator ceases to rise. Turn the lubricator handwheel 25—30 turns so as to force the lubricating oil to the lubrication points, making the pistons move together and apart.

Note. If the Diesel-driven compressor is going to be started after overhaul or long-term lay-off, it is necessary to somewhat turn out the bolts fastening the oil pipes to the lubrication points and to turn the lubricator handwheel until oil appears from underneath the bolts at all the lubrication points. Then the bolts should be fastened down and the lubricator handwheel be turned 25—30 turns with the pistons being moved together and apart at the same time.

3. Fill the grease cup of the lubricator drive with grease or petrolatum and tighten up the cover.
4. Examine the Diesel-driven compressor, wipe it with clean rags and put all stray objects away.
5. Open the valves of the 1st, 2nd and 4th stages that are mounted on bracket 7.
6. Put the starting handle *275* on the projecting square of the fuel injection pump drive shaft *111*.
7. By turning starting handle *275* clockwise, bring the [illegible] apart to the 220 mm indication of stroke index *309*.
8. Lower starting latch *271* and bring the pistons [illegible] the cross-member pin comes against the latch.
9. Remove starting handle *275*.
10. Close the valves of the 1st, 2nd and 4th [illegible] on bracket 7.
11. Move fuel pump rack *123* to the left as far as [illegible]
12. Open the valves of the pressure gauges.
13. Open the stop valves at the moisture-oil [illegible] air discharge piping.
14. Open the stop valve on the starting air [illegible] ing air should be supplied to the hand-actuated [illegible] at the pressure of 26 to 30 kg/sq. cm.
15. Open the stop valves on the fuel and water [illegible]
16. Blow through the starting air system [illegible] water, for which purpose:

a) open the blow-through valve and let the air blow out of the starting air bottle (the compressed air bottle from which the Diesel-driven compressor is going to be started);

b) open the upper blow-through valve arranged in bracket *7*.

17. Open the drain cock on the silencer to make sure that there is no water in it.

18. Prime the water pump suction piping and the pump itself with water.

19. Care should be taken to periodically check the condition of the internal surfaces through the inspection holes (not less than once a week).

B. STARTING

20. Pump up the fuel by fuel pump handle *131*, moving it two or three times.

21. Depress lever *250* of the hand-actuated starting valve as far as it goes and watch the pressure gauges of the 1st, 2nd and 3rd stages. At the moment of starting the pressure in the 2nd and 3rd stages should be within 24—26 kg/sq. cm and that in the 1st stage should be 4—6 kg/sq. cm. If in starting the pressures are below the said values, the trouble should be eliminated according to instructions in Section "G", "Diesel-driven Compressor Troubles and Remedies".

Note. In case the Diesel-driven compressor fails to be started for some trouble and the starting air has already entered the compressor cylinders, it is necessary to eliminate the trouble immediately and to start the compressor so that all the moisture carried in with the compressed air be removed from the compressor cylinders.

22. After starting the Diesel-driven compressor it is necessary to proceed as follows:

a) close the stop valve in the starting air piping;

b) open the upper blow-through valve and let out the starting air from the starting system;

c) adjust the pressure gauges so that the pointers come to rest. With the conter-pressure of 230 kg/sq. cm after the 4th stage the working pressures in the stages should be as follows:

1st stage	3—4 kg/sq. cm,
2nd stage	14—17 kg/sq. cm,
3rd stage	55—64 kg/sq. cm;

d) check the speed of the lubricator shaft (3—5.5 r. p. m.) and see that the cooling water is being supplied (looking through sight glass *22*);

e) shift fuel pump rack *123* by one tooth to the right to "1" position.

23. Watch the operation of the pressure maintaining valve and in case of its icing (the air is being delivered to empty sections), raise the pressure in the moisture-oil trap to 50—60 kg/sq. cm by turning the trap outlet valve, and maintain this pressure in the trap until the pressure in the sections reaches the same value.

If a pressure and temperature regulator is installed on the Diesel-driven compressor instead of the pressure maintaining valve, prior to starting the compressor for operation with increased counter-pressure on the exhaust for 0.3±0.2 kg/sq. cm (220± ±150 mm Hg — operating conditions of the compressor together with main Diesel engines having a common exhaust), it is necessary to open the stop valve 321 and deliver air from 2nd stage to the regulator plunger. Air compresses the regulator spring thus ensuring the pressure of 205±5 kg/sq. cm. In case of difficult starting of the Diesel-driven compressor at this operating conditions, it is necessary to start it with throttling the exhaust. In this case the Diesel-driven compressor is started with closed valve of the exhaust piping which is to be opened right after the first runs of the compressor.

C. ATTENDANCE DURING OPERATION

Important!

When the Diesel-driven compressor is running, it is strictly forbidden to interfere with stop *262* or lever *272* since **the elevation of the stop and turning of the lever to the left will inevitably result in breakdown.**

When stop *262* is raised and lever *272* is turned to the left, the starting latch lowers and assumes its starting position in which it is to be brought only at the moment of starting the Diesel-driven compressor. But if the latch happens to assume its starting position during the operation of the Diesel-driven compressor, the pin of the 1st stage piston cross-member will keep knocking against the latch bringing the 1st stage piston under intolerable impact loads that give rise to bending and breaking stresses and are bound to result in the ultimate breakage of the piston in the vicinity of the pin.

24. Periodically but not less than once an hour:

a) drain the condensate from the air coolers of the 1st, 2nd and 4th stages;

b) blow through the moisture-oil trap on the air discharge piping to remove the condensate from it;

c) drain the used oil from the receiver.

25. Check the amount of lubricating oil against the oil level indicator. Fill in the grease cup of the lubricator drive when required and tighten up its cover.

Periodically check the r. p. m. of the lubricator drive shaft on which the handwheel is fitted. The shaft speed should be within 3—5.5 r. p. m.

26. If the Diesel-driven compressor is going to be in operation for a long time, check the action of the 4th stage safety valve by slowly closing the stop valve on the air discharge piping while watching the 4th stage pressure gauge. When the pressure rises to 240—245 kg/sq. cm the Diesel-driven compressor should stop automatically. The pressure should never be allowed to rise above 250 kg/sq. cm.

Note. If the Diesel-driven compressor fails to stop automatically, care should be taken to eliminate the trouble.

27. See that there is sufficient air in the starting air bottle and fill up the bottle to a pressure of not more than 150 kg/sq. cm when required.

28. When any troubles appear (knocks in the interior, increase in pressure, etc.) stop the Diesel-driven compressor immediately, find out the cause of the trouble and eliminate it (See part "Diesel-Driven Compressor Troubles and Remedies").

29. Watch the condition of water through the sight glass.

When the Diesel unit and compressor interiors are packed properly one can see through the sight glass individual small air bubbles or groups of bubbles appeared from time to time due to insignificant amount of air blown-in from the atmosphere through the water pipeline where the packing is not very tight. Such bubbling in the course of operation is admissible. However, intensive bubbling is not admissible.

To find out places and causes for air penetration, proceed as follows:

a) stop the Diesel-driven compressor operation and without releasing the air from the compressor spaces, look through the sight glass. If the compressor spaces are properly packed there is no bubbling seen through the sight glass;

b) when the nozzle body packing is suspected of being faulty, stop the compressor, disconnect the water pump and with the water system filled-in, start the compressor for 2—3 minutes. If the injector body packing is reliable, the bubbles should not appear.

30. Periodically check the tightness of all the connections and fasten loose ones, if any. Special attention should be given to the fastening of the coupling flanges of the shafts of the water pump and its drive.

31. Periodically, i. e. every 100—150 hours of the compressor operation, clean the lubricator oil reservoir and filter from sludge and the scavenging air receiver interior from waste oil.

32. Periodically check the sight glass for cleanliness and, if necessary, clean it.

D. STOPPING THE DIESEL-DRIVEN COMPRESSOR

33. Turn the lubricator shaft 25—30 times by the handwheel.

34. Lift manual priming handle *131* of the fuel pump until it comes to stop.

E. PROCEDURE AFTER STOPPING

35. If the cooling of the Diesel-driven compressor is effected from an outside water supply main, close the stop valve on the water supply pipe immediately on stopping the compressor as the circulation of cold water in the water spaces of the shut-down compressor will cause the condensation of moisture on the working surfaces of the compressor cylinders and hence corrosion of parts.

36. Close the valve of the fuel tank.

37. Open the valves of the 1st, 2nd and 4th stages.

38. Shift fuel pump rack *123* to the right as far as it goes.

39. Close the stop valves on the air discharge piping and on the water-oil trap.

40. Open drain cock *35* of the scavenging air receiver and drain the waste oil.

41. Bring the pistons apart and leave them in this position so that condensed water could be removed from the internal surfaces of the compressor cylinders after the machine cools down.

42. In case the ambient air temperature drops below 0° C, open all the drain cocks for cooling water and condensate of the air coolers as well as those of the compressor and engine cylinders and of the water pump immediately after stopping. When water ceases to drop from the cocks, clean the latter with wire and leave them open.

F. ATTENDANCE DURING SHORT TIME AND LONG-TERM LAY-OFFS

When it is laid off for a short period of time (not longer than one month), the Diesel-driven compressor should be maintained in ready-for-operation condition. For this purpose proceed as follows:

1. Everyday rotate the lubricator handwheel 20—30 turns and then bring the pistons twice together and apart by means of the starting handle.

2. Once a week start the compressor and run it for 15—20 min.

Before starting examine the condition of the internal surfaces of the Diesel-driven compressor through the inspection holes. In case of corrosion, wipe the surfaces and lubricate them with oil used for compressor lubrication.

If the Diesel-driven compressor is going to be laid off for a month or more, the compressor should be subjected to anticorro-

sion treatment according to the indications given in section "Removal of slushing compounds and anticorrosion treatment".

G. DIESEL-DRIVEN COMPRESSOR TROUBLES AND REMEDIES

Below are described likely troubles of the Diesel-driven compressor and methods of eliminating them.

Cause	Remedy
I. The Compressor Starts Too Early (at a pressure in the 1st stage below 4 kg/sq. cm)	
1. Unreliable engagement of the starting latch with the cross-member	Adjust the engaging height of the latch against the cross-member pin to 4.0—5.5 mm by using the gasket of appropriate thickness underneath the self-acting starting mechanism flange
2. Incorrect adjustment of the self-acting starting valve	Adjust the self-acting starting valve for operation at a pressure of 4—6 kg/sq cm as indicated by the pressure gauge of the 1st stage
II. Knocks After Starting and During Operation	
1. Suction or discharge valves of compression stages have dropped out or been damaged	Stop the compressor immediately. Locate the likely place of trouble by noting deviation in readings of pressure gauges, disassemble the corresponding stage and check suction and discharge valves by lifting the valve disks for this purpose. Replace the damaged valves or parts
2. Too early starting which is a direct violation of item 21 of instructions for operation	See section i "The compressor starts too early". If knocks were only temporary, replace the copper protective screws at the next overhaul
3. Forced starting of the compressor with starting air pressures below 4 kg/sq. cm in the 1st stage and below 24 kg/sq. cm in the 2nd and 3rd stages, by lowering the starting latch manually	It is strictly forbidden to start the compressor by this method
III. The Compressor Does not Start	
1. The fuel pump rack is not in full charge position	Shift the fuel pump rack to full charge position, i. e. to the stop

Cause	Remedy
2. The float chamber is not filled with fuel or no fuel priming has been done	Fill the float chamber with fuel. Bring the pistons apart and prime the fuel 2—3 times by the hand-priming lever. Remove the float chamber cover and check the float for free motion. If the needle jams, eliminate the trouble
3. The pistons have not been brought to starting position	Bring the pistons to starting position
4. Water has got into the fuel	Close the stop valve of the fuel tank. Turn out the screw plugging the hole drilled in the filter bottom cover underneath the float chamber. If water is discovered, drain all the fuel and wash the float chamber. Check the fuel supply piping for water. Fill the float chamber. Prime it with hand-priming lever after disconnecting the high pressure pipe from the nozzle
5. The pressure of the starting air is below 26 kg/sq. cm	Adjust the pressure of the starting air so that it be within 26—35 kg/sq. cm
6. Too much bending of the two-member link prevents the starting latch from disengagement, or the spring of the self-acting starting valve is adjusted for a pressure higher than 6 kg/sq. cm	Decrease the bending of the two-member link by placing a washer under the nut shoulder so that the arm pivot of the link be not farther than 0.5 mm from straight line position. When starting the Diesel-driven compressor, adjust the self-acting starting valve for an opening pressure of 4—6 kg/sq. cm (according to 1st stage pressure gauge)
7. Fuel leakage through untight connection or rupture of the high pressure pipe	Fasten the connection of the high pressure pipe to the nozzle. Check the seat surfaces between the nozzle needle and the knife-edge filter tube at joint faces and also the clearance between the needle tip and the spray seat (the clearance should be not less than 0.5 mm). Use a new high pressure pipe

Cause	Remedy
8. Air bag in the high pressure pipe	Loosen the high pressure pipe a few turns of the thread at connection to the nozzle and prime the fuel by the hand-priming handle until the fuel appears from under the union nut
9. Nozzle is clogged (it is indicated by heating-up of high pressure pipe)	Take out the nozzle spray with the needle. Clean and wash the needle and nozzle spray in the Diesel fuel
10. Discharge valve of the fuel injection pump is damaged	Disassemble the discharge valve. If inserts or body are found to be damaged, use a new discharge valve. Replace broken springs
11. The plunger sticks during preparatory priming of fuel due to dirt, corrosion or deformation	Dismantle the pump head. Check the plunger pair of the fuel pump and, if fault is discovered with any part of the pair, replace both the plunger barrel and the plunger. Wash the float chamber and the filter
12. The plunger of the fuel injection pump has been assembled incorrectly (supposing after overhaul)	The plunger of the fuel pump should be so assembled that the marks on the plunger and marks on the barrel register when the toothed rack is shifted to the right as far as it goes
13. The plunger barrel of the fuel pump is not tight-sealed which may be determined by appearance of air bubbles in the float chamber of the fuel pump (a likely case after overhaul)	Thoroughly seal the fuel pump plunger barrel with a copper gasket
14. Incorrect setting of fuel pump cam (a likely case after overhaul)	For setting the cam in correct position proceed as follows. Open the valves of the 1st and 4th stages, check the float chamber for being filled with fuel and shift the fuel pump rack to maximum charge position ("0" tooth), remove the high pressure pipe and bring the pistons to 35—40 mm indication on the stroke index scale. With the hand-priming

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Cause	Remedy
	handle, drive the fuel up through the pipe from the plunger pair till it fills the pipe and comes out of the discharge connector. Proceeding to bring the pistons together the fuel level in the connector will indicate the beginning of discharge which is accompanied by the fuel level rise in the connector. The excess of fuel should be removed from the connector and the pistons should be slowly brought together to come to the fuel injection end when the fuel level in the connector ceases to rise and should occur within 17—19 mm indication of the stroke index. If the end of injection is after 19 mm indication (early injection), the cam on the shaft should be turned to the right. If the end of injection is before 17 mm indication (late injection), the cam should be turned to the left. The cam is fitted on the cone without any key and is held with a nut. Before turning the cam, it is necessary to mark its initial position on the flange cover. This is done with a ruler placed on the flat portion of the cam. It is established that a difference of 1 mm between the markings of the initial and new position will approximate to a 3 mm travel of the pistons from the initial position to the new one.
15. Water has got into the engine	Remove the water from the engine by the following method. Drain water from the exhaust piping. Turning the starting handle, bring the pistons apart till they come to stop, open the drain cock on the intermediate casing. Drain water from the Diesel-engine, disconnect the high pressure pipe and disassemble the nozzle. Bring the pistons together and, using a clean cloth, remove water from the power cylinder through the hole for nozzle.

Cause	Remedy
There is a leakage:	
a) through the copper gasket packing between the nozzle body and engine liner;	a) Drain the cooling water, remove the high pressure pipe and disassemble the nozzle. Insert a new copper gasket and tighten it securely, taking care to lubricate the thread beforehand
b) at lubrication connector joint (lubrication point 5 or 8);	b) Drain the cooling water. Remove water from the engine liner. Remove the connectors. Use new gasket under neath the connectors
c) through damaged rubber packing rings in the exhaust manifold	c) Take out the engine liner and replace the rubber rings
16. Flame or compression rings are broken. If the nozzle is damaged or clogged from one end the flame ring is liable to "burning" under the fuel jet. The break may also be caused by excessive advance of fuel injection or by fuel not corresponding to that specified in the Description of the Diesel-driven compressor	Replace the damaged rings. Take out all parts of the nozzle except for the nozzle body and body head. Carefully clean the nozzle needle and spray, wash them in clean Diesel fue . Check the end of fuel feed for correct timing (17—19 mm). See that the fuel grade corresponds to that recommended in the Description of the Diesel-driven compressor
IV. The Compressor Stops Immediately After Starting or During Operation	
1. The exhaust ports are carbonized	Clean the exhaust ports
2. Fuel supply piping is closed	Open the fuel supply piping
3. The fuel used does not correspond to that specified in the Description of the compressor	Change the fuel
4. Water in fuel	Eliminate the trouble as indicated above (see section III, item 4)
5. The fuel supply piping is clogged	Wash the fuel supply piping
6. Leakage of fuel from the high pressure pipe through untight connection or burst of the pipe	Eliminate the trouble as indicated above (see section III, item 7)

Cause	Remedy
7. Self-stopping of the Diesel-driven compressor at a pressure lower than 240 kg sq. cm:	
a) untightness of the 4th stage safety valve for air;	a) Disassemble the safety valve and replace the rubber insert;
b) the spring of the safety valve is not sufficiently loaded	b) turn out the stop screw and slowly turn the cup on till the safety valve operates at a pressure of 240—245 kg sq. cm after the 4th stage (nominal pressure 230 kg sq. cm)
8. The pressure maintaining valve has been iced	Heat it up
9. Piston seizing, due to lack of lubrication or poor cooling	Feel all the oil pipings. Hot piping is a sign of lubrication lack. In this case, check the oil level in the lubricator and oil feed. Increase the lubricator discharge to the overheated points
10. The toothed rack jams	If the compressor motion mechanism turns with great manual effort, it is necessary to remove the covers from the inspection openings and to feel the pistons and racks. Should scores or scratches be found, the mechanism must be disassembled and the defective places must be cleaned. Check the toothed racks and the 1st and 2nd stage pistons for easy movement
V. Smoky Exhaust	
1. The high pressure pipe is clogged which can be determined from its overheating	Wash the high pressure pipe
2. The silencer-filter has been choked	Wash it with weak soda solution
3. Incorrect mounting of the silencer-filter with additional suction pipe connection	Mount the silencer-filter according to the drawing

Cause	Remedy
4. The end of fuel injection occurs at less than 17 mm from dead centre—incorrect mounting of fuel cam	Fix the fuel cam as described above (see section III, item 14)
5. The exhaust ports are carbonized	Clean the ports
6. The scavenging air valves are not airtight	Remove the 1st and 4th stage cover and the 1st stage casing. Check the scavenging valves by lifting the valve disks. Replace the damaged valves
7. Incorrect mounting of the scavenging air valve board	Remove the inspection opening covers of the intermediate casing and see that the scavenging air channels in the 1st and 4th stage casing register with five 30 mm dia. holes in the valve board
5. Excessive fuel charge which may be caused by incorrect mounting of the fuel pump plunger	The mark on the plunger should register with that on the barrel when the toothed rack is shifted to the right as far as it goes

VI. Jerky Operation (Varying stroke)

1. The discharge valve in the fuel pump head is damaged	Eliminate the trouble as indicated above (see section III, item 10)

VII. Shaking of Compressor

The motion mechanism is not balanced (a likely case after overhaul)	Disassemble the motion mechanism. The weight of the mechanism at the scavenging side should not differ from that of the mechanism at the exhaust side by more than 10 grams. Make the weights equal

Cause	Remedy
VIII. Abnormal Pressure in Stages	
1. Pressure in the 1st stage is lower than normal (untightness of suction or discharge valves in the 1st stage) 2. Pressure in the 2nd stage drops while that in the 1st stage rises sharply (untightness or damage of suction or discharge valves in the 2nd stage) 3. Pressure in the 3rd stage drops while that in the 2nd stage rises sharply (untightness or damage of suction or discharge valves in the 3rd stage) 4. Pressure in the 4th stage drops while that in the 3rd stage rises sharply (untightness or damage of suction or discharge valve in the 4th stage)	Check the valves by lifting valve disks. Replace the damaged ones. Remember that the Diesel-driven compressor employs six units of valves
5. Leakage from under the 1st—4th stage cover (the cover sealing gasket is not properly tightened)	Remove the 1st and 4th stage cover, replace the gasket Ø 265 Ø 262× × Ø 1.5 and tighten the cover uniformly
IX. The Compressor Does not Stop Automatically	
1. The pipe line from the 4th stage safety valve to the fuel pump rack is either clogged or disconnected	Blow the pipe line through or connect it
2. Distance between the plunger top and the barrel top end is more than 9.5 mm with the plunger being brought to its extreme lower position	The tappet is worn or damaged. Replace the tappet and adjust the given distance within 9.3—9.5 mm. If it is not possible to replace the tappet, adjust the distance by reducing a number of gaskets under the pump head
X. Too Much Air Seen Through the Sight Glass	
1. Unfight joint between the nozzle body and engine liner	See section III, item 15

Cause	Remedy
2. Untight joint as the suction or discharge connector in the 4th stage	Tighten the suction or discharge connector of the 4th stage. If this does not help, replace the copper gasket. Lubricate the thread when fitting the connector in place
3. Untightness in the 3rd stage valve ring	Remove the 2nd—3rd stage head, unfasten the 3rd stage cover. Carefully and accurately fit the valve ring in the head. Put the head in vertical position for this purpose. Set the 3rd stage cover, fasten it and then mount the 2nd—3rd stage head on the compressor
4. Untight joints at lubrication connectors (lubrication points 4 and 9)	Replace the copper gaskets underneath the connectors
5. Untight rubber packing rings in the cooling water jacket of the 4th stage	Replace the rubber packing rings
XI. The Sight Glass Shows Feeble Flow of Water	
1. The cocks are closed either on the suction or discharge pipes	Open the cocks
2. The water pump valve is damaged	Replace the valve
3. Wear of the water pump bearings	Replace the bearings
4. Break of packing slip rings	Replace the rings
XII. Decrease in the Lubricator R. P. M.	
1. The drive roller coupling is not lubricated	Lubricate the coupling

Cause	Remedy
2. The oil piping is clogged	Clean the piping and blow it through
3. Non-return valves in the oil pipings leading to the 2nd, 3rd and 4th stages are either clogged or assembled incorrectly	When installing, see that the pointer on the valve body is in correct position

XIII. Increased Temperature of Oil Piping

1. Insufficient amount of oil; the oil level pointer has sunk to the casing	Refill the lubricator reservoir with oil
2. Incorrect adjustment of oil charge	The amount of oil delivered by the lubricator plungers is varied by turning with a screw-driver the adjusting screws that are located under the lubricator cover. The oil charge is increased by turning the screw counter-clockwise and it is reduced by turning the screw clockwise. The detent spring clicks four times as the screw is turned round. The clicks are to give guidance in the lubricator adjustment which should be carried out in accordance with the adjustment table given in the compressor description. In adjustment one should always proceed from the maximun oil charge for which the screw shou d be turned counter-clockwise till it comes to stop ("0" corresponds to full charge), and then the screw shou'd be turned clockwise for the number of clicks specified in the given table. When starting the compressor the first time after a long-term lay-off or overhaul, it is necessary to detach the lubrication connectors at lubrication points 1 and 6 on the engine casing and abundantly lubricate the toothed racks at these points
3. Wear of sprocket in the oil pump drive	Replace the sprocket

H. SCHEDULED PREVENTATIVE INSPECTION AND MAINTENANCE

The periodical scheduled preventative inspection and maintenance being a necessary prerequisite to assure normal and faultless operation of the Diesel-driven compressor should be carried out in time and in full scope.

Worn-out parts should be replaced by spares delivered as standard equipment with every Diesel-driven compressor and intended to be in operation for the whole service term till next maintenance after 1,000 hours of operation.

Inspection and Maintenance Are Classified as Follows.

1. Scheduled preventative inspection is undertaken every 250 hours of operation but not less than once a year.
2. Scheduled preventative maintenance is undertaken every 500 hours of operation.
3. Maintenance work is undertaken after 1,000 hours of operation.

1. SCHEDULED PREVENTATIVE INSPECTION

1. Dismantle the silencer-filter and disassemble it for cleaning. Clean and wash the silencer-filter parts with weak soda solution and then wash them with water.
2. Dismantle the lubricator. Clean the lubricator screens and the oil reservoir from sludge, carefully wash them with Diesel fuel and wipe dry.
3. Clean the sight glass from deposits.
4. Take the nozzle spray out, carefully clean it from carbon and thoroughly wash it in Diesel fuel.
5. Check the condition of rubber connections in the water piping. Renew the damaged hoses.
6. Check the tightness of bolted connections.
7. Check the piston stroke index scale for correct mounting.
8. Check the advance of fuel injection which should be timed so that the end of injection be within 17—19 mm. Adjust it, if necessary.
9. Check the end play of the fuel pump shaft.
10. Check the starting air reducer for correct adjustment (150 kg/sq. cm×30 kg/sq. cm).
11. Start the Diesel-driven compressor and check the operation of:

a) the regulating valve on the hand-actuated starting valve (16÷18 kg/sq. cm);

b) the safety valve on the hand-actuated starting valve (26.5±1 kg/sq. cm);

c) self-acting starting valve (4÷6 kg/sq. cm).

If necessary, adjust them.

12. With the compressor being in operation, check:

a) the adjustment of the pressure maintaining valve (150 kg/sq. cm) or pressure and temperature regulator (150±5 kg/sq. cm and 205±5 kg/sq. cm);

b) the adjustment of the 4th stage safety valve (240÷245 kg/sq. cm);

c) hourly fuel consumption at a pressure of 230 kg/sq. cm after the 4th stage (8.5—8.7 kg/hr);

d) the lubricator oil points for correct adjustment by the r. p. m. of the lubricator shaft, and hourly oil consumption;

e) cooling water for being free from air (through the sight glass);

f) the water pump delivery (1.6—2.2 cu.m/hr);

g) the adjustment of the safety valve on the starting air bottle (150 kg/sq. cm).

In case of necessity, accomplish the adjustment needed.

2. SCHEDULED PREVENTATIVE MAINTENANCE

The scheduled preventative maintenance is undertaken in order to clean the machine from sludge and carbon deposit, to check the condition of assemblies and parts, and to replace a number of parts.

To do this, the Diesel-driven compressor should be dismantled in main assemblies and the following work should be carried out.

Engine Casing

Press the cylinder out. Carefully wash the parts in Diesel fuel and wipe them dry. The water-washed external surfaces of the cylinder should be cleaned from scale and from traces of old zinc coat and should be zinc-coated anew. The thickness of the zinc coat should not be less than 0.1 mm. Inspect the mirror-finished working surfaces of the cylinder and clean scratches and scores, if any, with a whetstone (manually) or by machine honing. Take the measurements of the cylinder according to the logbook data and make entries in the logbook.

Replace the rubber gaskets underneath the cooling water pipe connection and the rubber rings on the cylinder. Replace the gaskets underneath the nozzle body, lubrication connectors, lubrication bolts.

Replace the zinc insert of the protector if badly corroded (which is likely to happen when working in sea water).

Intermediate Casing

Thoroughly wash and wipe the intermediate casing, giving special attention to the lubricator tank.

2nd Stage Casing

Press the 2nd stage liner out.

Turn the valves out. Thoroughly wash all the parts and wipe them. The mirror-finished working surface of the cylinder should be perfectly smooth.

Clean the water-washed external surface of the 2nd stage liner to metallic shine and paint it with minium.

Disassemble the valves. Replace the worn-out springs, disks and seats. When replacing the seats it is necessary to check the valve lift which should be within 2.0—2.2 mm. It is not permitted to use caps and seats of one valve for mounting them on the other. The rubber and copper packing rings on the liner should be replaced too.

Clean the zinc protector from oxidation or replace it, if badly corroded.

Replace the gaskets underneath the lubrication connector and the lubrication bolts. Take the measurements of the liner according to the logbook data and make entries in the logbook.

1st Stage Casing

Press the liner out. Turn the valves out. Thoroughly wash all the parts and wipe them. Clean the water-washed external surface of the 1st stage liner from oxidation and scale to metallic shine and paint it with minium. Disassemble the valves.

Replace the springs and disks of the scavenging valves in the 1st stage liner. Replace the worn-out seats, springs and disks of other valves. When replacing the seats, check the valve lift which should be within 2.0—2.2 mm.

It is not permitted to mount the 1st stage casing valves on the 1st stage liner or vice versa, or to use caps and seats of one valve for mounting them on the other.

Replace the rubber packing rings on the liner.

Replace the gaskets underneath the liner and lubrication connector, and the lubrication bolt. Take the measurement of the liner according to the logbook data and make entries in the logbook.

1st and 4th Stage Cover

Dismantle the cover. Wash and wipe all the parts. Water-washed external surfaces of pipe connections, liner and head

should be thoroughly cleaned from oxidation and zinc-coated again with cadmium underlayer. The thickness of cadmium layer should be from 0.03 to 0.04 mm and that of zinc 0.04 mm.

Replace the suction and discharge valves of the 4th stage.

Replace the zinc protectors, if badly corroded.

Thoroughly wash the lubrication pipe and blow it through. Replace the rubber packing rings on the liner and jacket.

Replace the copper gaskets under the pipe connections and liner (if the liner has been turned out of the head) as well as under the lubrication bolt.

2nd and 3rd Stage Head

Dismantle the head. Thoroughly wash all parts, blow them with compressed air and wipe dry. Dismantle and inspect the parts of the 2nd stage suction valves.

Replace the valves of the 3rd stage.

Replace the seats of the 2nd stage valves and springs and disks of the 2nd stage valves which have been considerably worn out or damaged.

It is not permitted to interchange the valves of the 2nd and 3rd stages, or to use the valve caps and seats of one valve for mounting them on the other. After the valves have been assembled, check the valve lift which should be within 2—2.2 mm. Replace the protectors, if badly corroded. Take the liner measurements according to the logbook data and make entries in the logbook.

Replace the gaskets under the lubrication bolt.

Motion Mechanism

Remove the piston rings.

Disassemble the ball-joint connections.

Thoroughly clean all the parts from carbon and scale, wash them and wipe dry, paying special attention to the cleanliness of the rings and grooves. Replace the power piston rings (flame and compression ones).

Examine the condition of the pistons, rings and ball-pivot joints. The rings should have no rubbed or scored marks, should be smooth and well worn-in at their working surfaces. The 4th stage rings, if worn out by more than 20% in weight, should be replaced. (The weight of a new set of the 4th stage piston rings is 15 grams). The piston rings of the 3rd stage should be replaced if worn out by more than 8% in weight. (The weight of a new set of the piston rings is 22 grams). The piston rings of the 1st and 2nd stages usually are good for service without replacement for 1,000 hours. They are to be replaced, if worn out by more than

7% in weight. The weights of new ring sets are 206 and 144 grams for the 1st stage and 2nd stage respectively.

The packing ring in the valve board should be replaced in case the 1st stage piston rod shows signs of abnormal performance of the ring, i. e. score marks appeared on the piston rod in the form of longitudinal traces. When replacing the ring, care should also be taken to clean the piston rod. When assembling the ball-pivot joints, see that they rotate freely and have no axial play.

Inspect the tapered surface of the cross-member pin contacting the starting latch. Replace the pin if dents, edge chipping or crumpling are discovered on it (which can be the result of non-observance of operating instructions).

Slight burning of the power piston crowns (rough surface) should be cleaned with emery cloth.

When running the machine after overhaul, pay attention to the proper operation of the fuel injection apparatus. The racks on the cross-member may have a slight axial play (less than 0.05).

Dismantle the discharge valves in the valve board and inspect them. Replace damaged or worn-out parts (springs and disks). The valve disk lift is to be 2—2.2 mm. After they have been fitted in the grooves, the piston rings should move easily. When assembling the 4th stage piston, see that the intermediate rings of the 4th stage are correctly fitted on the rod. In case of corrosion of the intermediate rings of the 4th stage piston the whole set of the piston together with the rings should be replaced. Take the measurements of the power pistons and the 1st, 2nd, 3rd and 4th stage pistons of the compressor according to the logbook data.

Fuel and Lubrication Apparatus

Care should be taken to maintain thorough cleanliness when dismantling and assembling the fuel apparatus:

Fuel Pump and Nozzle. Dismantle the fuel pump and the nozzle.

Thoroughly wash the parts in Diesel fuel and wipe them dry. Examine the condition of all the parts, paying special attention to the condition of the needle bearings, tappet, lever roller, cam, springs and spring disks. Replace the plunger pair, discharge valve, shaft packing ring, nozzle spray and needle.

Remove the fuel filter and thoroughly wash it in Diesel fuel. Wash the float chamber without removing the float. Thoroughly wash the rod and casing of the nozzle knife-edge filter and the high pressure pipe with Diesel fuel. Replace the copper gaskets under the body and spray of the nozzle.

Lubricator. Dismantle and carefully wash without stripping.

The oil pipes should be washed with Diesel fuel, blown through and flushed with Diesel lubricating oil.

Water Pump with Drive Gear

Disassemble the pump, wash it thoroughly and wipe dry. Inspect all parts of the pump and replace the drive packing ring. Replace the textolite coupling and fluorine plastic bearing bushes. After the bushes are pressed in, they should be reamed for 22 A dia.

Replace the ebonite and rubber rings for packing the water pump shaft, and if scores are detected on the packing flange bush shoulder over which the ebonite ring moves, clean this surface.

If scoring is found on the bronze bushes of the water pump shaft, eliminate it by rubbing softly. Inspect the water pump valves, replacing their disks and springs. In case the seats are worn out considerably, they should be replaced as well. The valve disk lift is within 2—2.2 mm. Clean the packing surface on the water pump safety valve disk and replace rubber packings in the valve board.

Coolers

Disassemble and wash the coolers. Clean thoroughly their water-washed surfaces removing oxides and deposits.

Test the pipe units of the 2nd, 3rd and 4th stage coolers by applying hydraulic and air pressure:

2nd stage unit . . P_{hydr} = 40 kg/sq.cm, P_{air} = 27 kg/sq.cm
3rd stage unit . . P_{hydr} = 90 kg/sq.cm, P_{air} = 60 kg/sq.cm
4th stage unit . . P_{hydr} =345 kg/sq.cm, P_{air} =230 kg/sq.cm

Replace rubber packing rings.

In the course of overhaul, see that the pipes and soldered joints are in good order. If need arises, solder the damaged spots and apply a ПСр-45 ГОСТ 8190—56 solder.

Pressure Maintaining Valve and Pressure and Temperature Regulator

Disassemble, wash and wipe the valve and regulator dry. Replace the rubber cups by new ones. When assembling, lubricate the components with specified oil.

Safety Valves, Distributing Valve, Starting and Take-Off Valves

Dismantle the valves, wash and check their components. Damaged components should be replaced. Replace all rubber packings. When replacing the rubber insert of the 4th stage safety valve, it is necessary to take into account that the pressed-in rubber insert should be fitted flush with the edge or be sunk to 0.5 mm deep. Metal valves are to be ground in to their seats. The metal part of the valves should be lubricated with specified oil.

Automatic Starting Mechanism

Disassemble and wash the mechanism, inspect its parts. Replace the flat spring. Inspect the bevelled surface of the latch and in case of crumpling or chipping (being the result of non-observance of maintenance instructions), replace the latch. If necessary, replace the automatic starting valve rubber packing.

Piping

Flush the water piping with an alkaline solution, then with water. Clean the air piping, wash it with Diesel fuel and thoroughly blow with air.

Silencer

If water has got inside the silencer in the course of service, it should be dismounted, disassembled and cleaned from carbon and corrosion deposits.

Coat the external surfaces of the silencer with a temperature-resistant black paint.

Fasteners and Small External Components

Inspect the fasteners, replacing the screws, bolts and studs in case of damage or strain of the thread, corrosion of the surface or wear of the slots.

Studs, bolts and nuts used for fastening housings and covers, for mounting the coolers, fuel pump and water pump gear drive should be made of steel having grade 35 or 40.

The fasteners made of steel having grade 20 or 30 may be used for other purposes.

Restoring the Varnish and Paint Coating

Wash thoroughly the external surface of the cooler and piping components to remove dirt or oil and degrease them.

Wherever damage to the filler or paint is found, the old filler or paint layer should be removed.

After refilling and drying, remove the [illegible] and clean the surfaces refilled. Coat the external surfaces of the Diesel compressor and coolers with navy grey oil enamel.

The water piping should be painted green, the piping coated with aluminium or blue paint, oil piping [illegible]

List of Parts to Be Replaced in Scheduled Preventative Maintenance

Item No.	Drawing No.	Description	Quantity, pcs.
1	938-36.463	Packing ring	1
2	ДК2-02.125	Spring	1
3	ДК2-02.166	Bearing bush (left-hand)	1
4	ДК2-02.170	Coupling	1
5	ДК2-02.174	Bearing bush (right-hand)	1
6	ДК2-02.183	Sliding ring	1
7	ДК2-03.117	Piston ring	6
8	ДК2-03.125	Flame ring	2
9	ДК2-05.004А	Valve	1
10	ДК2-05.009А	Valve	3
11	ДК2-05.156	Disk	30
12	ДК2-08.124	Insert	1
13	ДК2-08.172	Packing ring	1
14	ДК2-10.005—1	Plunger with barrel	1
15	ДК2-10.007	Packing ring	1
16	ДК2-10.010	Discharge valve	1
17	ДК2-10.016	Nozzle with needle	1
18	ДК2-10.135	Gasket	1
19	ДК2-10.191	Gasket	1
20	ДК2-10.251	Gasket	1
21	21727,6	Washer, ⌀ 12 × ⌀ 18 × 1.5	3
22	924-4119	Washer	2
23	935-36.059	Spring	24

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Item No.	Drawing No.	Description	Quantity, pcs.
24	938-1194	Washer, ∅ 263 × ∅ 260 × 1.5	1
25	938-1195	Washer, ∅ 12 × ∅ 18 × 1.5	3
26	938-1196	Washer, ∅ 14 × ∅ 8 × 1	20
27	938-1198	Washer, ∅ 133 × ∅ 130 × 1.5	1
28	938-1109	Washer, ∅ 59 × ∅ 55 × 1.5	1
29	938-1110	Washer, ∅ 64 × ∅ 60 × 1.5	1
30	938-1113	Washer, ∅ 43 × ∅ 40 × 1.5	2
31	938-1141	Gasket	1
32	938-1142	Gasket	1
33	938-1144	Gasket	2
34	938-1173	Packing ring	
		$Д_0 = 20$	5
		$Д_0 = 25$	2
		$Д_0 = 30$	5
		$Д_0 = 36$	3
		$Д_0 = 45$	6
		$Д_0 = 75$	2
		$Д_0 = 100$	1
		$Д_0 = 112$	1
		$Д_0 = 118$	4
		$Д_0 = 130$	1
		$Д_0 = 212$	1
35	938-1189	Packing ring	1
36	ДК2-10.028-1	Filtering medium	1
37	ДК10-09.139	Packing	1
38	ДК2-05.012	4th stage discharge valve	1
39	938-СК2	Collar	1
40	938-СК3	Collar	2
41	938-СК7	Collar	1
42	938-64.077	Packing ring	1
43	ДК10-09.187	Seeling	3
44	less drawing	Ring 21-[illegible] × 5-[illegible] ГОСТ 9833-61	1

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3. CURRENT MAINTENANCE

Current maintenance of the Diesel-driven compressor is aimed at replacement of worn-out parts and recovering its normal service qualities.

The Diesel-driven compressor maintenance consists of disassembling, washing the units and parts, inspecting and measuring the parts and making up the list of parts to be repaired. The maintenance involves replacement of all parts included in the preventative maintenance list.

Besides, it is necessary to replace the parts listed below.

A necessity for replacement or repairs of other parts is determined in trouble shooting.

Item No.	Drawing No.	Description	Quantity, pcs.
1	ДК2-00.005	Clip	16
2	ДК2-02.169	Shaft sleeve (left-hand)	1
3	ДК2-02.172	Shaft sleeve (right-hand)	1
4	ДК2-02.187	Bush	1
5	ДК2-02.189	Packing holder	1
6	ДК2-02.206	Carrier	1
7	ДК2-02.303	Housing	1
8	ДК2-02.304	Stop	1
9	ДК2-02.326	Spring	1
10	ДК2-03.102	Piston ring	2
11	ДК2-03.107	Packing ring	1
12	ДК2-03.128	Piston ring	12
13	ДК2-03.139	Piston ring	4
14	ДК2-03.140	Piston ring	8
15	ДК2-05.007	Spherical disk valve	[illegible]
16	ДК2-05.008	Spherical disk valve	48
17	ДК2-05.010А	Spherical disk valve	24
[illegible]			[illegible]

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Item No.	Drawing No.	Description	Quantity, pcs.
18	ДК2-08.177А	Insert	1
19	ДК2-10.023	Pump element, assembled	10
20	ДК2-10.270-2	Sprocket	1
21	ДК2-10.311-3	Roller	7
22	558-И1	Protection plate insert	2
23	924-И63	Washer	1
24	less drawing	Rubberized coupling ∅ 22, L = 70, ГОСТ 1819—42	8

IV. INSTRUCTIONS FOR DISASSEMBLING AND ASSEMBLING

These instructions do not contain a detailed description of the Diesel compressor assembling and disassembling procedure, but just present basic directions for assembling and disassembling, use of special tools and methods of checking the Diesel-driven compressor assembling and adjustment.

A. DISASSEMBLING

Directions for use of special tools and accessories in disassembling.

Diesel Engine Casing

a) Removal of the cylinder clip by means of a special strap (Fig. 9):

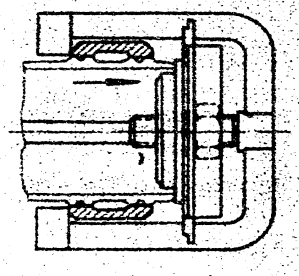

Fig. 9

b) pressing out the Diesel cylinder with the aid of a special tool (Fig. 10).

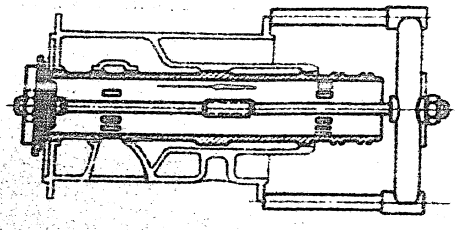

Fig. 10

1st Stage Casing

Pressing out the 1st stage cylinder liner with the aid of a special tool (Fig. 11).

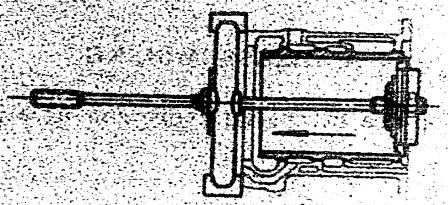

Fig. 11

2nd and 3rd Stage Casing

Pressing out the 2nd stage cylinder liner with the aid of a special tool (Fig. 12).

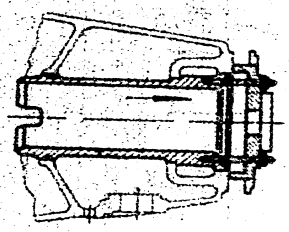

Fig. 12

2nd and 3rd Stage Head

a) Screwing-out and screwing-in the 3rd stage suction valves with the help of a special wrench (Fig. 13);

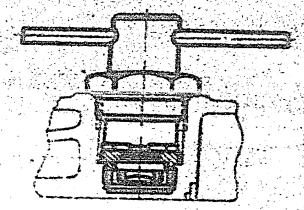

Fig. 13

b) removal of the valve ring from 2nd and 3rd stage head by means of a special wrench (Fig. 14).

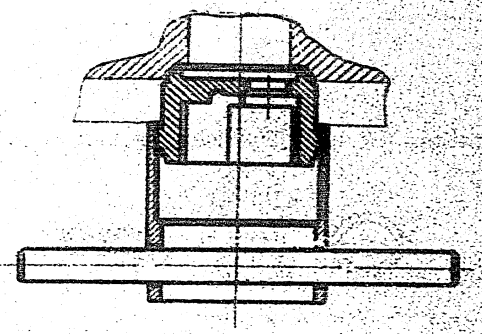

Fig. 14

Water Pump with Drive Gear

a) Pressing the bronze bush out from the water pump shaft by means of a special tool (Fig. 15);

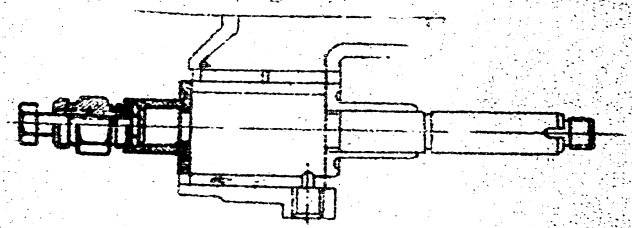

Fig. 15

b) removal of the cone sleeves from the water pump and drive shafts by means of a special tool (Fig. 16).

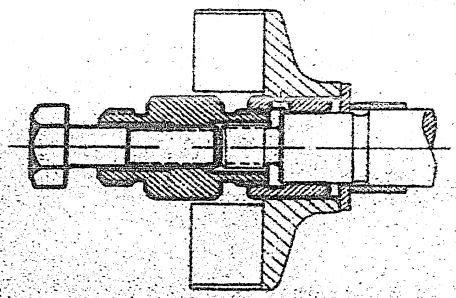

Fig. 16

Nozzle

a) Dismantling the nozzle needle by means of a special eye bolt (Fig. 17).

Fig. 17

b) removal of the nozzle spray from the casing by means of a special tool (Fig. 18).

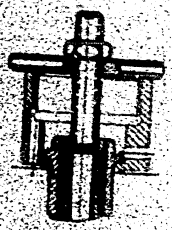

Fig. 18

4th Stage Piston

Removal of the piston assembly from the rod by means of a special tool (Fig. 19).

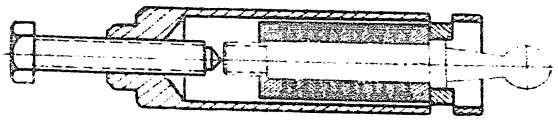

Fig. 19

Self-Acting Valves

a) Valve dismantling by means of special tools and a wrench (Fig. 20).

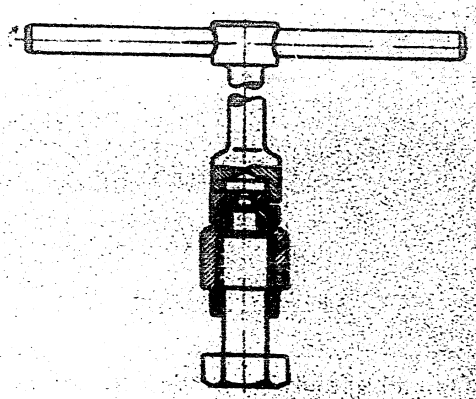

Fig. 20

b) screwing out the 3rd and 4th stage valve seats and the scavenging pump (on 1st stage bush) from their recesses by means of a special tool (Fig. 21);

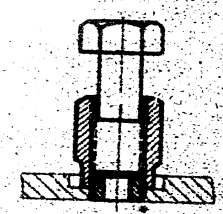

Fig. 21

c) screwing out the 1st and 2nd stage valve seats, scavenging pump and water pump from their recesses by means of a special tool (Fig. 22);

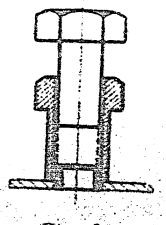

Fig. 22

d) screwing out valve seats by means of a special tool used when it is impossible to screw out the seat with the aid of the tools mentioned in "b" and "c" items (Fig. 23).

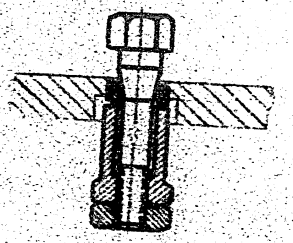

Fig. 23

Disassembling and Assembling the Fuel Pump

(for plunger and barrel replacement)

1. Turn off the screw and nut and take out the discharge valve with washer and packing ring.

2. Turn off the nuts and remove the fuel pump head; take out the plunger with disks and spring.

3. Press out the plunger barrel from the pump head.

4. Mount the plunger (from a new set) with the gear wheel pressed-on in the pump casing, having fitted the disks and spring beforehand. With the rack pulled out as far as it goes, the plunger mark should register with that on the barrel. When handling such precision pairs, particular care should be taken to keeping them clean. It is forbidden to dismantle the barrel and plunger unit.

5. Press the plunger barrel in the head, having inserted a washer under the barrel. Mount the head on the casing, install the discharge valve and snap the plunger pair.

6. Remove the discharge valve.

7. Place the plunger in its lowest position and check the distance between the upper edges of the plunger and the barrel. The value obtained should be 9.4±0.1 mm (see Fig. 33). If necessary, adjust the distance by changing the washers under the head. Check the plunger for smooth travel in the barrel under different conditions (i. e. without the discharge valve and with the discharge valve mounted in its proper place).

Disassembling and Assembling the Lubricator

(for pump element replacement)

1. Dismount the filter.

2. Turn off the nuts and screws, remove the bed plate with pump elements.

3. Replace the elements as necessary, preventing them from getting dirty. It is forbidden to take the pump elements apart.

4. Mount the bed plate with the elements on the lubricator and fix it there, then mount the filter.

5. Check the lubricator drive gear for smooth rotation and turn all screws of the tappet as far as they go, bearing in mind that the screw thread is a left-hand one.

B. ASSEMBLING

When assembling the units, keep them clean making sure that no chips, dirt or dust get inside the machine.

1. ASSEMBLY OF THE UNITS

Assembling the Diesel Engine Casing

1. Fit the packing rings upon the engine cylinder, beginning from the scavenging side and proceeding as follows:

a) packing ring, D_0=118 mm;
b) ditto, D_0=118 mm;
c) ditto, D_0=130 mm;
d) ditto, D_0=118 mm;
e) ditto, D_0=118 mm;
f) ditto, D_0=112 mm.

2. Press the engine cylinder in the engine casing by means of a special tool (see Fig. 24).

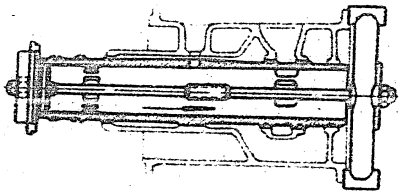

Fig. 24

In the course of pressing-in, see that the holes for the nozzle and lubricating pipe connection in the engine cylinder fully register with those in the engine casing.

3. Place a washer, Ø 22.5×Ø 24.5×1, into the hole for the engine cylinder nozzle.

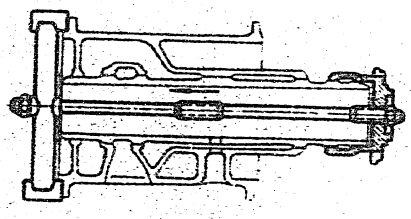

Fig. 25

4. Insert the nozzle body in the nozzle body head and fit a packing ring ($Д_0$=25) upon the body.

Prior to installing the nozzle body, make sure that the safety pin is fitted in the head.

5. Mount the nozzle body assembled with the head upon the engine casing.

6. Screw in the lubricating pipe connection, together with Ø 13.5×Ø 20×2 gasket.

7. Press on the holder with the aid of a special tool so that the lubricating ports in the engine cylinder register with those in the holder (Fig. 25).

8. Screw in the lubricating pipe connection flow or over with the gasket in the cylinder lubricating port.

9. Mount the pipe bend with its gaskets.

10. Test the casing water chambers at a hydraulic pressure of 6 kg/sq. cm.

Notes.

1. When re-pressing bronze guide bushes, ream or scrape their inside to a size of $\varnothing 25^{+0.21}_{+0.13}$ mm.

2. When assembling, the holes for the lubricating and water pipe connections in the intermediate casing should, by all means, register with those in the holder.

Assembling the 1st and 4th Compressor Stage Casing

1. Screw 30 valves in the 1st stage casing and 24 valves in the 1st stage cylinder liner.

2. Fit a rubber packing ring ($Д_0$=212 mm) and Ø 260×Ø 263×Ø 1.5 copper washer on the liner. Press the liner in the 1st stage casing by means of a special tool (see Fig. 26) making sure that the holes for the lubricating pipe connection in the casing register with those in the liner.

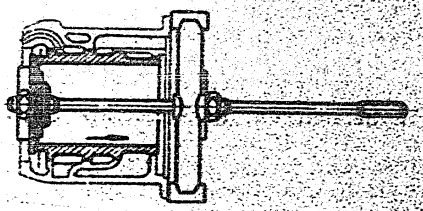

Fig. 26

3. Having inserted a Ø 12×Ø 18×1 washer, screw in the lubricating pipe connection.

4. Test the casing water chamber at a hydraulic pressure of 6 kg/sq. cm.

Assembling the 2nd and 3rd Stage Casing

1. Screw 8 spherical valves in the 2nd stage liner with the aid of a special tool.

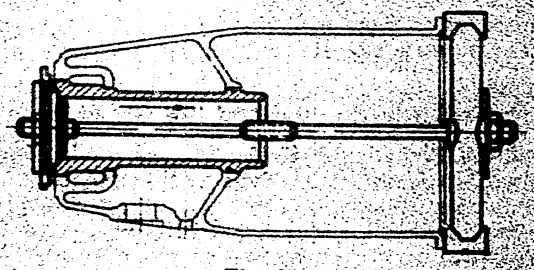

Fig. 27

2. Press the 2nd stage cylinder liner in the 2nd and 3rd stage casing by means of a special tool (see Fig. 27), having fitted a rubber packing ring, $D_0=100$ mm, and Ø 133×Ø 130×Ø 1.5 copper washer.

Note. The holes for the lubricating pipe connection in the casing should register with those in the liner.

3. Screw in the lubricating pipe connection, having inserted Ø 12×Ø 18×1 washer under it.

4. Test the 2nd and 3rd stage casing water chambers at a hydraulic pressure of 6 kg sq cm.

When testing, fit the 2nd and 3rd stage head on the casing.

Assembling the 1st and 4th Stage Head

1. Assemble the discharge branch pipe by inserting the valve cap, spring and disk and screwing in the seat.

Note. When replacing the cap or seat, check the valve lift (1.2±0.1 mm).

2. Screw the spherical valve in the 4th stage suction branch pipe.

3. Assemble the head with the 4th stage cylinder liner by screwing the 4th stage cylinder liner with the washer in the 4th stage head. Select the washer thickness so that the hole in the liner for the coupling bolt would face the hole for the suction branch pipe.

4. Install the 4th stage lubricating oil pipe, connecting it to the liner by M8 coupling bolt. Lock the bolt by lock washers.

5. Mount the head with the 4th stage cylinder liner assembled with the lubricating oil pipe in the 1st and 4th stage cover, screw the suction and discharge branch pipes assembled, using Ø 40× ×Ø 43×1.5 gaskets.

6. Fit two packing rings ($D_0=25$ mm) upon the 4th stage cylinder liner and one packing ring ($D_0=7.5$ mm) upon the water jacket.

Press the water jacket in the 1st and 4th stage cover.

7. Test the 1st and 4th stage head at a hydraulic pressure of 6 kg/sq.cm.

Assembling the 2nd and 3rd Stage Head

1. Screw three 3rd stage discharge valves in the valve ring.
2. Screw 3rd stage suction valves in the sleeves.
3. Screw nine 2nd stage suction valves in the head.
4. Screw the sleeves assembled with the valves in the head.
5. Mount the following components into the head bore: Ø 55× ×Ø 59×1.5 washer, valve ring assembled with the valves, Ø 60×

×Ø 64×1.5 washer, and 3rd stage cover with a packing ring ($Д_0$=75 mm) fitted on it; the cover should be fastened by nuts.

6. Fit three copper safety screws in the head.

7. Complete the assembling and test the water chambers at a hydraulic pressure of 6 kg/sq.cm.

Assembling the Piston Unit (Exhaust Side)

1. Mount three piston rings and a flame ring on the engine piston. Check the edge clearances of the piston rings in the grooves which should be as follows (in mm): 0.17—0.32 at the flame ring, 0.095—0.14 at the first compression ring, 0.025—0.07 at the second and third compression rings.

Notes

1. When machining the stop screws, they should be filled so that to ensure 0.1 mm axial clearance between the ring and the detent after fitting the rings.

2. With the rings compressed in the screws as far as they go, the ring lock clearance should be 1.5 mm.

2. Assemble the 3rd stage piston unit proceeding as follows:

a) fit the 3rd stage piston rings on the 3rd stage piston;

b) insert ball-shaped end of the rod in the 3rd stage piston, install the step bearing and lock washer, fix the pressure nut;

c) proceeding as above, assemble the rod with the step bearing. Check whether a Ø 4 mm round pin is provided on the step bearing.

The pin should protrude by 2 mm.

When replacing the ball joint components of the piston unit, or in case they have been worn out, fit these components tightly to each other and check the tightness by blueing. The ball joint should rotate without play or seizing. Prior to final assembling give the ball surfaces a coat of graphite lubricant.

3. Check the cross-member for coupling with the 2nd stage piston. The cross member which is coupled to the piston by the cross-member stud should have no play.

4. Insert the 3rd stage piston unit in the 2nd stage piston together with the support screw on and tighten the M16 nut, and lock it with Ø 4×35 cotter pin.

Note. When replacing the piston components, make sure that the distance between the 3rd and 2nd stage piston edges is 98±1.0.

5. Check the presence of the chamfered pin and install the engine piston, fixing it with M16 nut and Ø 4×35 cotter pin.

6. Fit a lock washer upon the 2nd stage piston and fix it with M8×15 screw, lock the screw.

7. Connect the racks with the cross-member, using bushes and locking the bushes by screws.

In case of replacing the racks, cross-member or 2nd stage piston, make sure that the racks are parallel to the piston axis. Checking should be made with the aid of prisms placed in two positions with a turn of 180°. Upward departure of the free end of the rack over 200 mm length should not exceed 0.15 mm from the piston axis.

8. Install four 2nd stage piston rings.

9. When replacing the piston unit components, check the weight of the assembly (which should be 30.125±0.005 kg). The weight adjustment should be done wherever indicated in the drawings.

Assembling the Piston Unit

(Scavenging Side)

1. The engine piston assembling procedure is similar to that described in item 1 of the above section.

2. Assemble the 4th stage piston by fitting the intermediate and piston rings upon the stud with a ball-shaped head. When installing the intermediate rings, follow sequence of their numbers, and fasten the rings by Ø2×45 wire. Screw on the M10 nut and lock it with a cotter pin.

3. Assemble the 4th stage piston unit by inserting the ball-shaped heads into the 4th stage piston rod, fit the ring thrust bearings and tighten them by pressure nuts. Lock the nuts by M4×2.5 locking screws.

When assembling the 4th stage piston group, follow the same directions as those adopted for assembling the 3rd stage piston unit (see item 2 of the above section).

4. Assemble the scavenging air valve board by inserting the packing ring in the board and screwing-in 31 valves.

5. Fit the 4th stage piston unit with a spacer, in the 1st stage piston; the spacer being locked by M16 nut. Fix the nut by a cotter pin, and check the distance between the 1st and 4th stage piston edges (61±1 mm).

6. Mount the scavenging air valve board on the 1st stage piston.

7. Mount the engine piston on the 1st stage piston, following the same directions as those adopted for the 2nd stage piston (see item 5 of the above section).

8. Connect the cross-member with the 1st stage piston by a stud. Lock the stud by a washer and M8×15 screw.

9. Fit the racks and check them for being parallel, following a procedure similar to that adopted for the 2nd stage piston (see item 7 of the above section).

10. Fit the 1st stage piston rings on the piston. The rings should travel freely, i. e. without sticking.

11. When replacing any components of the piston unit, check the weight of the unit assembled. The weight should be 30.125± ±0.005 kg.

The weight adjustment is to be carried out as specified in the drawings.

Assembling the Water Pump

1. Remove the left-hand bush from the pump shaft and mount the shaft in the pump casing. Replace the left-hand bush and lock it by a nut. Check the shaft throw in the bush with partition. The shaft throw in the bush should be within 0.15 to 0.3 mm. Lock the nut on the water pump shaft (see Diesel-Driven Compressor Service Log).

2. Fit the packing case, having inserted shims under it, and fix it by M8 nuts. Check the shaft throw that should be within the limits of 0.075 to 0.15 mm. Adjust the throw by changing gaskets between the packing case and pump casing.

3. Fit the bearing cap, having placed gaskets in the housing bore, and lock it by M8 nuts. Check the shaft throw which should be within 0.075 to 0.05 mm. Adjust the throw by changing gaskets between the bearing cap and the pump casing.

4. Fit the packing on the pump shaft by mounting the carrier, tapered spring (with its smaller diameter facing the carrier), washer, packing ring and packing casing with a sliding ring. Insert gasket and packing flange. Screw in and tighten four M6×20 bolts.

5. Fit a washer, engagement flange, cone sleeve assembled with the pin and lock washer, fixing them all by a special nut.

Notes.

1. Place the cone sleeve so that the pin end protruding inside the sleeve would enter the pump shaft groove, while the outside end would enter the engagement coupling slot.

2. When assembling the pump and drive gear, fit the lock washers *168* to their proper places having fully tightened cone sleeves *158* by nuts *171* (see Album of Drawings Sheet 16). To tighten the cone sleeves, use temporary washers. Non-observance of this requirement may result in damage to lock washers and loosening of cone sleeves.

3. The fixing lug of the lock washer should face the cone sleeve.

4. When replacing the mounting flange or cone sleeve, fit the tapered surfaces of these components to each other with checking by blueing. For secure tightening of the cone sleeve protrusion of its edge over the flange plane should be not less than 1.5 mm.

6. Assemble the valve board, having inserted eight spherical valves in it.

7. Assemble the water pump head by fitting the gaskets, valve spring and valve proper upon the guide. Fit the guide assembled with the valve upon the head and fix it by four nuts.

When replacing a guide or a valve, grind in the valve to the head, and adjust the valve opening for a pressure of 2 kg/sq.cm by selecting shims under the guide flange. The adjustment should also be checked when replacing a spring.

8. Fit the lower (rubber) packing, valve board assembled and upper (rubber) packing on the pump.

Note. Make sure that a pin is pressed in the valve board.

9. Fit the head assembled upon the water pump casing and secure it by two M12 nuts.

10. Fit the lubricating oil pipes.

11. Test the water pump assembled for tightness at a hydraulic pressure of 3 kg/sq.cm. Insignificant leakage through the shaft packing may be disregarded.

Assembling the Water Pump Drive Gear

Assembling the Water Pump Drive Shaft

Assembling the water pump drive gear shaft is made only when replacing a gear wheel or drive gear shaft.

1. Heat the gear wheel in an oil bath up to 160 or 180° C.

2. Press the gear wheel on the shaft

a) When pressing the gear wheel on the shaft, make sure that the marks provided on the gear wheel and on the shaft butt end register;

b) when pressed on, the gear wheel should face the shaft shoulder.

Assembling the Lubricator Drive Gear

1. Fit the following components upon the rod: a packing gland nut, guide bush and gasket.

2. Connect the shackle to the driving rod by a spindle.

3. Fit the washer and lock the spindle by a Ø2×20 cotter pin. A 2×30° chamfer provided on the cam inner surface, the spindle hole for cotter pin and the flat on the rod lower end should face the same side.

Assembling the Drive Gear Cover

(to be carried out when replacing a bush or bearing cap)

1. Press the needle bearing bush in the bearing cap. In this case, make sure that the hole for a screw in the bush should register with the threaded hole in the cap. The 3×15° chamfer on the bush should face the cap edge.

2. Fit the washer and tighten the lock screw.

Assembling the Drive Gear Casing

(to be carried out when replacing the drive gear casing or bush)

Press the bush in the drive gear casing and make sure that the bush shoulder faces the bore for the ball bearing, and the lubrication grooves in the bush face register with the lubrication hole in the drive gear casing.

Final Assembly of the Water Pump Drive Gear

Warning!

There happened cases when **damage to the water pump drive** gear has occured **due to incorrect disassembling and reassembling** of the drive gear.

To avoid such cases, **strictly follow the present instructions** when overhauling the drive gear on board.

1. Using grease, fix 38 needle rollers (3 mm in dia., 16 mm long) to the 2nd journal of the pump drive shaft (the 1st journal bears the gear wheel) and insert the shaft into the drive gear cover.

2. Using grease, fix 32 needle rollers to the 3rd journal drive shaft, and fit the lubricator drive upon it. Place a gasket upon the cover. A flat on the lower part of the lubricator drive rod should face the gear wheel fitted on the shaft.

3. Using grease, fix 29 needle rollers to the 4th journal of the drive shaft, fit the drive gear casing on it (assembled with the bush) and screw in two M10×80 bolts, with Ø 14×Ø 8×1 washers connecting the drive gear cover to the drive gear casing.

4. Press in ball bearing No. 204, ГОСТ 8338—57.

5. Press a packing ring into the clamping ring and lock it by a spring washer.

6. Mount the clamping ring assembled with the packing ring in the drive gear casing, install three Ø 8.5 spring washers, screw on and lock three M8 nuts.

7. Using an adjusting pin available in the set of special tools and accessories, fix the drive gear shaft (by putting the pin through the hole provided in the wheel and drive gear) and mount the parts as follows: a distance piece, washer, coupling flange, cone sleeve, lock washer (its fixing lug facing the cone sleeve) and a special nut.

Having tightened the cone sleeve by a nut, prevent the nut from loosening by bending the edge of the lock washer.

To achieve secure tightening of the cone sleeve, proceed as follows: a) when assembling, check the lock washer fixing lug for cracking, tearing and pronounced corrosion pitting; b) check the cone sleeve edge extension above the plane of the coupling flange.

With the bush tightened, the extension should be not lees than 1.5 mm (if less, it might occur that the tapered bush although resting with its front edge against the washer, still does not fix the coupling flange).

It is particularly important to have this check carried out when replacing the cone sleeve or engagement flange.

Notes.

a) A pin should be pressed on the coupling flange;

b) when replacing the cone sleeve or coupling flange, tightly fit the cone surfaces of these components with checking by blueing;

c) the mark on the coupling flange should coincide with the tip of the pointer fitted on the pump drive gear casing.

8. Take out the adjusting pin and check the drive gear for smooth rotation. The drive gear shaft should turn freely, without seizing. Using Ø 1 mm wire, lock two bolts fastening the drive gear cover to the drive gear housing.

Assembling the Automatic Starting Mechanism

Assemble the automatic starting valve.

Having completed the assembling, check the position of the piston rear edge relative to discharge port, i. e. zise *a* as shown

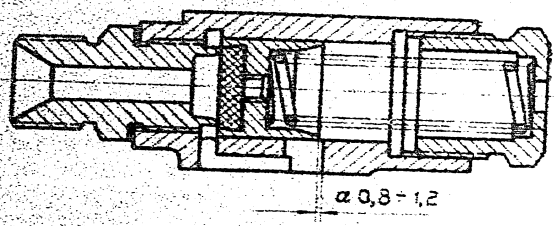

Fig. 28

in Fig. 28. For efficient operation of the gear, size *a* should be kept within 0.8—1.2 mm.

Adjust the automatic valve so as it would open at an air pressure of 5.5 kg/sq. cm. Having completed the adjustment, lock the threaded bush by M4×6 screw.

2. Assemble the automatic starting mechanism referring to the drawing. In this case bear in mind:

a) 0.5+0.5 mm and 91 mm sizes are to be checked when replacing the automatic starting mechanism components. If necessary, adjust these sizes;

b) to replace the levers or shaft, drill, where necessary, and ream by means of a tapered reamer the holes for the pins and the stop.

3. Make sure that the holes for compressed air in the automatic starting valve register with those in the casing, then mount the automatic starting valve on the casing and fix it by nuts.

Assembling the Pressure Maintaining Valve

1. Using the drawing for reference, assemble the valve (see album, sheet 21).

2. When replacing valve parts, check the rod travel which should be within 2+0.5 mm (adjust it with the aid of gaskets).

3. When replacing the non-return valve components, test it for tightness at an air pressure of 230 kg/sq. cm, with the adjusting cup turned off as far as it goes.

4. When replacing the valve stem or seat, check the stem spherical surface for its fitting to the seat.

5. Adjust the valve at a pressure of 150 kg/sq. cm.

Assembling the Pressure and Temperature Regulator

1. Using the drawing (album sheet 22) assemble the pressure and temperature regulator.

2. Realize the reseating of the regulator valve stem *256* and valve *126* together so that the stem move in the valve under the action of its own weight.

3. Reseat the stem and valve, to seat *254*. Surface *F* should be prevented from paste.

4. In case of replacement of spring *185*, it is necessary to set dimension *H* so that it were smaller than the actual free length of the spring for 2.7—2.8 mm, the nut *257* being tightened up to stop.

The dimension adjustment is effected by undercutting the nut end face *B*.

5. Set the regulator valve stroke *S* within the limits of 1 to 1.2 mm, for which purpose tighten nut *257* up to stop and then unturn it for ½ turn.

6. Tightness *e* between nut *144* and collar *258* is adjusted by tighting the nut up to stop and by using a set of adjusting rings *143*. The tightness should be within the limits of 0.5 to 0.8 mm.

7. Stroke *a* of pusher *316* should be adjusted within the limits of 2 to 2.5 mm by employing gaskets *317*.

8. Stroke *б* of plunger *141* should be set preliminarily for 3 mm by adjusting nut *142*.

9. Screw up throttling screw *319* up to stop and then unscrew it for 2 clicks, that is for ⅛ turn.

10. Preliminarily adjust the pressure maintaining valve for 150 kg/sq. cm, for which purpose compress the spring for 6 mm

by sleeve *139* (three revolutions of the sleeve) from the moment of beginning of the spring compression. The final adjustment of the regulator for pressure and temperature required is accomplished on the engine.

To increase the additional pressure (additional compression of the spring to maintain the pressure of 205 kg/sq. cm) somewhat unscrew nut *142* and to reduce the pressure the nut is to be tightened.

Using screw *319* set the temperature of air heating so that at maximum difference between the 4th stage (not less than 205 kg/sq. cm) and the section (0 kg/sq. cm) the delivered air temperature after the regulator should be +1 to 2° C.

Before installing the regulator on the Diesel-driven compressor, its cavities are tested for tightness with following air pressures:

a) 230 kg/sq. cm — cavity *A* of the pressure maintaining regulator.

Air is supplied to pipe connection *Д* with pipe connections *E*, *K* and *Л* plugged. Air escape is not admitted.

b) 230 kg/sq. cm — non-return valve. Air is supplied to pipe connection *E*. Insignificant air escape from pipe connections *K* and *Д* is admitted, but it shall not extinguish the match flame.

c) 50 kg/sq. cm — regulator valve. Air is supplied to pipe connection *Л* with screw *319* unscrewed for 1/3 turn. Air escape from pipe connections *K* and *Д* is admitted, but it shall not extinguish the match flame.

d) 100 kg/sq. cm — pressure regulator (cavity *A*). Air is supplied to pipe connection *Д* with pipe connections *K* and *Л* plugged. Air escape from pipe connection *E* is admitted, but it shall not extinguish the match flame.

2. FINAL ASSEMBLY OF DIESEL-DRIVEN COMPRESSOR

Installing the Piston Units

1. Turn the adjacent piston rings on the 1st and 4th stage pistons to place their locks at an angle of 180° with respect to each other, lubricate the Diesel cylinder inner surface with Diesel oil and install the piston unit (scavenging side) in the Diesel casing.

The lug of the cross-member stud on the 1st stage piston should be located opposite the hole in the intermediate casing for the automatic starting mechanism.

To install the cross-member in a proper position, knock it against the Diesel cylinder so that the piston unit comes to the stop.

2. Turn the piston rings on the 2nd and 3rd stage pistons to place their locks at an angle of 180° with respect to each other, lubricate the Diesel cylinder internal surface with Diesel oil, and mount the piston unit (exhaust side) in the Diesel casing.

Note. Prior to mounting piston units, fit a clip upon the engine pistons to compress the piston rings.

Installing the Water Pump Drive Gear

1. Bring the piston units together as far as they go (watch through the nozzle hole).

2. Fit a paper gasket upon the Diesel casing connecting flange, install the water pump drive gear and lock it by nuts. Prior to installing the drive gear, see that the drive gear wheel hole register with the hole in the cover, for this purpose use a pin.

Installing the Fuel Pump

See to cleanness in all operations associated with the fuel pump installation.

1. Drain oil from the fuel pump and dismount the drive gear from it, having loosened the nut on the pointer and removing the pointer by knocking softly on the nut through the flange hole (see Fig. 29).

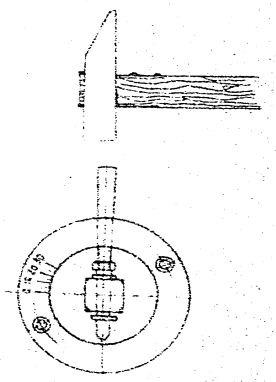

Fig. 29

2. Fix the fuel pump drive gear shaft having inserted the pin in the gear wheel and transmission shaft bearing cap holes. Check

size "15" from the screw centre to the nearest edge of the fuel pump cam (see Fig. 30).

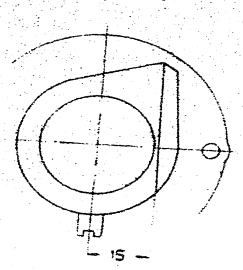

Fig. 30

Note. If the size exceeds 15—18 mm, loosen the nut fastening the cam, and fit the cam to the proper position by means of a special tool (Fig. 31).

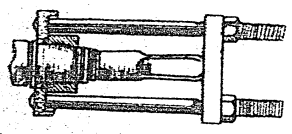

Fig. 31

3. Fit a set of paper gaskets on the Diesel casing connecting flange, make sure that the piston units are brought together as far as they go and mount the fuel pump drive gear on the Diesel casing.

See that the pin is inserted in the holes of the gear wheel and transmission shaft bearing cap.

4. Mount the fuel pump on the pump drive gear and secure it by three M12 nuts. Prior to installing the pump, rotate its transmission shaft so that the cam lug would be turned downwards. Raise the tappet roller, using the hand priming lever.

5. Check axial play of the transmission shaft. The play depends on the clearance between a thrust pin pressed in the Diesel casing and the transmission spindle ball. The axial play should be within 0.3—0.5 mm. Adjust the play by changing the gaskets between the Diesel casing flanges and transmission shaft bearing cap.

6. Shift the stroke index to the square end of the fuel pump drive transmission shaft and bring the pistons together as far as they go. In this case the stroke index pointer should register with

the stroke index scale zero. If not, loosen the screws fixing the scale and shift it as far as necessary (see Fig. 32).

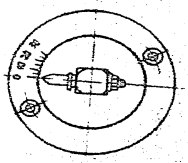

Fig. 32

7. Turn the transmission shaft through 180°,and shift the toothed rack to the right as far as it goes, putting it on OFF position. Remove the nut and the discharge valve from the fuel pump

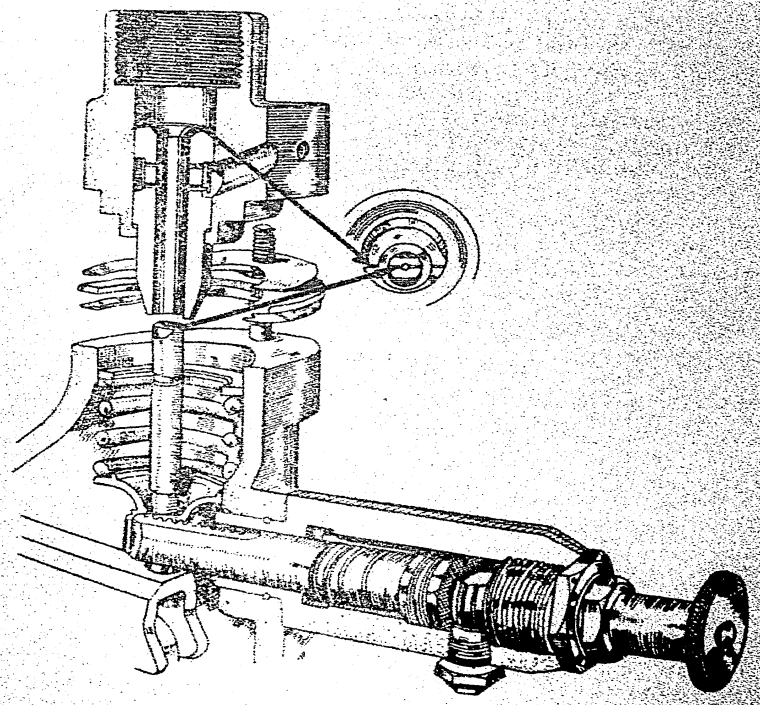

Fig. 33

With the shaft in this position:

a) the mark on the plunger face should register with the plunger barrel face marking. The permissible divergence should be within 0.5—1.00 mm (see Fig. 33);

b) the distance from the plunger face to the plunger barrel end should be 9.4±0.1 mm (see Fig. 34).

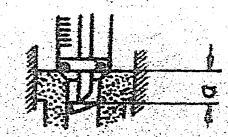

Fig. 34

If the marks on the plunger face and barrel end do not register, dismantle the fuel pump head together with the plunger pair, spring and spring disks, and shift the engagement of the gear fitted on the plunger as will as that of the toothed rack to the right or to the left, as necessary.

Changing the gaskets under the fuel pump head, adjust the above distance within 9.4±0.1 mm.

8. Check the plunger for smooth travel in the barrel, operating the pump hand priming lever; perform the check in three positions:

a) with tightened nuts of the fuel pump head;

b) with the toothed rack in various positions;

c) with the discharge valve and high pressure piping being installed.

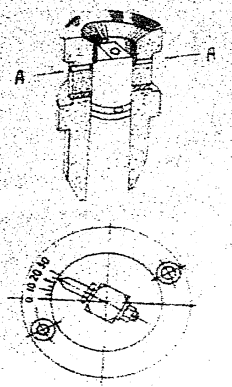

Fig. 35

9. Determine the starting of fuel supply (with the discharge valve removed), proceeding as follows: engage the fuel pump rack, shifting it to the left as far as it goes, fill the float chamber with fuel and rotate the pump spindle counter-clockwise (the

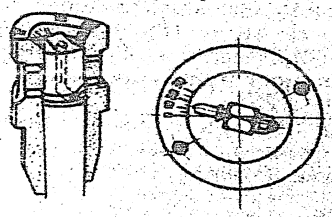

Fig. 36

stroke index pointer moving to the left and the engine pistons drawing together) until the upper holes *A* in the plunger barrel are closed, i. e. till stopping the fuel supply from these holes inside the sleeve. The index pointer should stop in this case on scale division "29" (see Fig. 35).

10. Determine the end of fuel supply by removing fuel from the plunger barrel with a piece of clean cheesecloth and proceed to turn the fuel pump spindle counter-clockwise until fuel starts leaking from the central hole. Make sure that the stroke index pointer is within 17—19 scale divisions (see Fig. 36).

If it happens that:

a) the pointer indicates a figure less than "17", then dismantle the fuel pump from the drive, loosen the nut, shift the cam to the left, using a special tool (Fig. 31), and tighten the nut;

b) the pointer indicates a figure over "19", then shift the cam to the right.

11. Fill the pump with lubricating oil (about 0.25 litre), mount the discharge valve in it, and tighten the nut.

Installing the Nozzle

When installing the nozzle, see to perfect cleanness.

1. Insert the nozzle spray with nozzle needle in the nozzle body mounted on the Diesel casing so that the round pin would enter the nozzle body head groove.

2. Insert a pressure bush assembled in the body head as far as it goes, holding by the tube hexahedron of the knife-edge filter. Fit one end of the high pressure pipe to the end of the nozzle knife-edge filter and the other one to the fuel pump coupling nut.

When fitting the pressure bush in the body head, avoid overtightening since it may result in sticking of the needle in the

nozzle spray due to the needle strain, and makes more difficult its dismantling for cleaning.

To provide for efficient tightness, the following directions should be observed:

a) when dismantling the nozzle without replacing the copper gasket under the nozzle spray (the gasket being snapped), turn the pressure bush in the needle as far as it goes, taking up the clearances, then once more tighten the bush by 1.5 or 2 key faces (turning through 90—120°);

b) when disassembling the nozzle and replacing the copper gasket (the gasket being non-snapped), tighten the bush by 3 or 3.5 key faces more (turning through 180—210°).

Installing the 1st and 4th Stage Casing

1. Place a gasket upon the intermediate casing flange and install the 1st and 4th stage casing, having coated the bush inside surface with lubricating oil.

Note.

1. To compress the 1st stage rings, fit a clip upon the 1st stage piston, when mounting the 1st and the 4th stage piston.

2. When installing the casing, make sure that the pin in the 1st and 4th stage casing has entered the valve board slot and the board holes register with the casing grooves.

Installing the 2nd and 3rd Stage Casing

1. Place a gasket upon the Diesel casing flange and install the 2nd and 3rd stage casing, having coated the inside surface of the 2nd stage bush with lubricating oil.

Note. To compress the piston rings, fit a clip upon the 2nd stage piston when installing the 2nd and 3rd stage casing.

Installing the 1st and 4th and 2nd and 3rd Stage Heads

1. Place a gasket in the 2nd and 3rd stage casing bore and mount the 2nd and 3rd stage head, having lubricated the 3rd stage cylinder liner with compressor oil.

Prior to installing, check the height of the thrust safety screws on the head. Their height should be not less than 6 mm. Fix the 2nd and 3rd stage head.

2. Place a gasket upon the face of the 1st stage cylinder liner and mount the 1st stage valve cover.

Bring the piston units apart as far as they go adjusting the screws to obtain simultaneous striking of the piston units against the screw heads.

The extent of adjusting the safety screws is determined by measuring the displacement of the valve cover being struck by the 1st stage piston. The height of the safety screws after adjustment should be not less than 4 mm.

The piston units in this case should be displaced by $255^{+1.0}$ from the middle.

3. Insert M3 22×2×20 tube into the water passage port provided in the 1st stage casing and fit a packing ring ($Д_o$=20 mm) on the tube.

4. Place a gasket of Ø 265×Ø 262×Ø 1.5, into the 1st stage casing bore, a copper gasket on the 1st and 4th stage head water jacket, mount the 1st and 4th stage head on the 1st stage casing, having lubricated the 4th stage cylinder liner inner surface. Screw on and tighten ten M12 nuts. Turn off the nuts and remove the 1st and 4th stage head. Make sure that the gaskets have been snapped; if not, choose the gaskets of an appropriate thickness for the jacket.

When mounting the 1st and 4th stage head, see that the valve holes in the 1st stage valve cover register with the holes in 1st stage cylinder liner.

Installing the Water Pump

1. Bring the piston units together and connect the water pump to the drive gear mounted on the machine. Simultaneously, mount the coupling between the coupling flanges fitted on the pump and drive gear shaft ends; check mutual overlapping of the flange cams which should be within 2.2—5.1 mm.

2. Remove lubricating tubes from the water pump head, turn out the nuts fastening the head to the pump casing, and remove the pump head together with the valve board.

Check the proper installation of the water pump: with the piston units brought together to the stop, the clearance between the pump bush partition and shaft vane should be not less than 0.8 mm; with the piston units brought apart as far as they go to the safety screws this clearance should be not less than 1.2 mm.

In case of any deviation, adjust the clearances by turning the coupling flange on the water pump drive spindle.

Install pump head, valve board and lubricating tubes.

Installing the Automatic Starting Mechanism

Mount the automatic starting mechanism and secure it by six M12 nuts. When mounting, check the latch engagement in the

cross-member stud. The engagement should be 4—5.5 mm in height. Adjust the engagement by changing gaskets under the starting mechanism.

C. CHECKS AND ADJUSTMENTS AFTER DIESEL-DRIVEN COMPRESSOR OVERHAUL OR MAINTENANCE

I. Prior to starting the Diesel-driven compressor the following checks should be made:

1. Tightness of the water chambers and mains.

Checking is carried out by filling all water chambers and piping with water from the water main.

No water leakage or seepage is permissible at static pressure in the nipple, pipe connection and flange joints or under the cylinder liner rubber packing rings.

To check rubber packing rings in the engine cylinder and 2nd stage cylinder cooling chambers, remove the sight hole covers on the intermediate and 2nd-3rd stage casing, inspect the packing joints, and make sure that there is no water leakage under the rings.

2. Tightness of air chambers and mains.

The checking method is as follows:

Fill all water piping and chambers with water (water level to be above the sight glass), then stop the water supply, bring the piston units apart, and fix them in starting position; then, let the starting air to the compressor cylinders up to the following pressures: not more than 4 kg/sq. cm in the 1st stage and not more than 24 kg/sq. cm in the 2nd, 3rd and 4th stages.

Make sure that there is neither air leakage through the air chamber and piping joints nor intensive bubbling seen through the sight glass.

N o t e. Intensive bubbling seen through the sight glass is indicative of air leakage to the water system.

Air leakage is most frequently observed in the following places:

a) under copper gaskets of the 4th stage suction and discharge branch pipes;

b) under copper gaskets of the 3rd stage valve ring;

c) under copper gaskets of the 1st, 2nd and 4th stage oil pipe connections.

Less often air leakage takes place:

a) under the copper gasket from the 1st stage delivery chamber to the 1st stage water jacket;

b) under the 1st stage rubber rings to the 4th stage water jacket.

The air leakage, if any, is detected by consecutive disconnection of water piping, as follows (when locating the leak point, maintain air pressure in the cylinders of each stage within the limite indicated above):

a) to check the 1st and 4th stage packings, disconnect (in their upper sections) first the water pipe from the 1st stage casing and then the water pipe from the 1st and 4th stage cover.

If intensive bubbling is seen through the open pipe connection on the 1st stage casing, it is an indication of air leakage from the 1st stage under the oil pipe connection of the 1st stage or under the copper gasket between the 1st stage cylinder and casing.

If intensive bubbling is observed through the open pipe connection of the 1st and 4th stage cover, this is an indication of leakage under the copper gaskets of the 4th stage branch pipes or under the rubber rings separating the 1st stage from water chambers.

b) To check the 2nd and 3rd stage packings, turn the water pipe (in its upper part) connecting the 2nd and 3rd stage head with the 2nd and 3rd stage casing.

Intensive bubbling observed through the open pipe connection is an indication of air leakage from the 3rd stage to the water chamber of the head, under the valve ring copper gaskets.

To check the packing of copper gaskets under the 2nd stage oil pipe connection or between the 2nd stage bush and the 2nd and 3rd stage casing, the water pipe connecting the 2nd and 3rd stage casing with the 1st stage cooler should be disconnected from the casing, then a check for intensive bubbling should be made by looking through the open pipe connection.

Air leakage to water chambers is eliminated in accordance with instructions given in section "Diesel-Driven Compressor Troubles and Remedies".

3. Oil supply from the lubricator to all oil pipe connections.

The method of checking is as follows. Bring apart the pistons shifting them as far as they go, check the system for oil supply to the pipe connections by disconnecting in turn the lubricating pipes from pipe connections in all points of lubrication and rotating the lubricator handwheel. The lubricator should be adjusted for full supply to all points of lubrication, except for some points on the Diesel that are adjusted in accordance with the libication chart

4. Correct installation of the water pump. The method of checking is as follows.

With the water pump head removed, check the clearance between the pump spindle blade and the pump casing bush partition. With the piston brought together to the stop, the clearance should

be not less than 0.8 mm, while with the pistons brought apart as far as they go, it should be not less than 1.2 mm.

5. Correct installation of the plunger pair and mounting of the fuel pump shaft cam.

The distance from the upper face of the plunger barrel to the plunger upper face should be 9.4 ± 0.1 mm. Having drained the plunger pair delivery chamber the fuel should appear through the plunger central bore, while the stroke index pointer is within 17—19 mm.

6. Fuel supply effected by the hand priming lever.

With the fuel pipe mounted in its place but disconnected from the stem type filter, and at abrupt lifts of the fuel pump hand priming lever, the fuel should eject from the free end of the fuel pipe in a strong and continuous jet.

II. Preparation for start, start and maintenance of the Diesel-driven compressor during operation should be carried out in compliance with the operating instructions.

III. When starting, check the adjustment of the automatic starting valve (4—6 kg/sq. cm).

IV. Immediately after starting, proceed as follows:

1. adjust the pressure maintaining valve for 150 ± 5 kg/sq. cm (the pressure is measured by the 4th stage pressure gauge), or pressure and temperature regulator for pressure of 150 ± 5 kg/sq.cm and 205 ± 5 kg/sq. cm,

2. check the packings of the air piping and chambers for tightness. The check is made by observing the cooling water flow through the sight glass. Air discharge through the joints of the air piping and chambers, or intensive bubbling observed through the sight glass are not permissible.

Note. Intensive air bubbling observed through the sight glass is indicative of gas or air leakage from the engine cylinder to the water chamber under the copper gaskets of the nozzle or engine oil pipe connections.

V. In one or two hours after the Diesel compressor starting, adjust the oil supply to individual points of lubrication according to the lubricator horizontal shaft speed as per the table given in description.

VI. During trial starting and running-in, check the Diesel-driven compressor for correct assembling and adjustment, to do this, proceed as follows.

1. Measure the delivery at the maximum fuel supply of 8.8 kg/hr ("O" position), reducing the delivery value obtained so as to meet the following requirements:

$$P_{bar} = 760 \text{ mm Hg}, \; t_{suc} = 20^{\circ} \text{C}, \; t_{} = 30^{\circ} \text{C},$$

using a formula given in the Diesel-driven compressor logbook.

Note. The fuel consumption is determined in the following way. A service tank filled with fuel and connected through a siphon pipe with the fuel pump fuel chamber is placed on a balance. Having switched over the fuel pump supply to the service tank, measure the time necessary for consumption of 500 gr of fuel. Hourly consumption of fuel is calculated by the formula:

$$q = \frac{0.5}{t_p} \cdot 60 \text{ (kg/hr)},$$

where t_p is the time in minutes required for consumption of 0.5 kg of fuel.

2. Check the water pump delivery. The pump filled with water should take water from a tank installed 2 metres below the water pump level. The pump delivery should be not less than 1.6 cu.m/hr at a back pressure not more than 1.6 kg/sq. cm and is determined by the time required for filling the reference tank with water discharged from the Diesel-driven compressor.

The delivery is calculated by the formula:

$$Q = \frac{V}{t_{fil}} \cdot 60 \text{ cu. m/hr},$$

where V — reference tank capacity (cu. metres); t_{fil} — time for filling the tank (minutes).

3. Check the oil consumption proceeding as follows. Weigh the oil to be poured into the tank under the lubricator. In an hour after the Diesel-driven compressor operation, drain the oil residue through the drain hole and weigh it. The lubricating oil consumption should be within 0.17—0.22 kg/hr.

4. Check the automatic stopping gear for operation. The method of checking is as follows. Increase the pressure behind the 4th stage, and see if the self-stopping of the Diesel-driven compressor takes place when the pressure amounts to 240—245 kg/sq.cm. If the self-stopping does not take place, adjust the 4th stage safety valve for operation at 240—245 kg/sq.cm. It is inadmissible to increase the pressure on the 4th stage over 250 kg/sq.cm.

In case of troubles in the Diesel-compressor operation, follow recommendations given in the section "Diesel-Driven Compressor Troubles and Remedies".

V. ANTICORROSION TREATMENT AND REMOVAL OF SLUSHING COMPOUND

If the Diesel-driven compressor is going to be laid off for a month or more, it should be subjected to anticorrosion treatment to prevent corrosion of the machine.

The anticorrosion treatment of the Diessel-driven compressor for operating conditions as well as at the Manufacturing works is effected as follows.

Materials Used for Anticorrosion Treatment and Their Preparation

For anticorrosion treatment the following materials are used:
a) anticorrosion greases K-17 BTУ НП 113—62 or K-19 BTУ НП 77—62;
b) diesel fuel "ДС" or "ДЗ" ГОСТ 4749—49;
c) commercial vaseline ГОСТ 782—59;
d) paraffined paper ГОСТ 9569—60 or special thin pergamyn ГОСТ 2995—56;
e) rags for cleaning ГОСТ 5354—50.

All materials used for anticorrosion treatment should meet the requirements of the State Standards and technical specifications.

Before employing the anticorrosion compounds should be checked in laboratory for absence of water and then thoroughly mixed in their containers.

Preparing Diesel-Driven Compressor for Anticorrosion Treatment

1. Prior to the treatment of the Diesel-driven compressor open the cover of the inspection manholes on the intermediate casing and the 2nd and 3rd stage casing, and make sure that no corrosion is formed. If any, the diesel-driven compressor should be dismantled to remove corrosion, scale and dirt. If no corrosion is found the machine should not be dismantled.

2. To facilitate the removal of condensate and contaminated oil from the compressor cavities the engine must be operated for 30 minutes.

3. Before stopping the machine for anticorrosion treatment it is necessary to drain condensate by turns from the air cavities through the 1st, 2nd and 4th stage scavenge valves and the drain cock of the scavenge air receiver.

4. After stopping the Diesel-driven compressor proceed as follows:

a) drain the specified oil from the cavities of the lubricator and fuel pump. Contamination in the mentioned cavities is not admitted;

b) clean the internal surfaces of the casing parts and motion gear of the compressor through the inspection ports;

c) clean the external unpainted surfaces of the engine. In case of corrosion remove it by using emery paper No. 000 soaked in oil. Corrosion being removed, the dressed area should be washed with Diesel fuel and wiped dry.

Internal Slushing

The Diesel-driven compressor should be slushed not later than 2 hours after being stopped.

To slush the machine proceed as follows:

1. Fill up the lubricator and fuel pump cavities with slushing compound.

2. Prepare the compressor for starting and then start it following the instructions for operation. The machine should be operated for one hour.

3. Stop the Diesel-driven compressor and thoroughly blow the condensate out of the compressor cylinders and scavenging receiver.

4. Let out the cooling liquid from all the cavities of the Diesel-driven compressor by opening the drain cocks and subsequent blowing through the cooling water system with compressed air of 3—4 kg/sq.cm pressure. The air is to be let in succession to the suction pipe connection of the water pump and to the discharge pipe connection on the sight glass. Scavenging is to be made until the water flow from the drain cocks of the system completely stops.

5. Drain the fuel from the float chamber, disconnect the high pressure pipe from the nozzle, and with the help of the hand-operated priming lever pump out the fuel remnants from the fuel pump.

6. Fill up the float chamber with slushing compound, pump it with the help of the hand-operated priming lever till the slush-

7*

ing compound appears in the high pressure pipe, and then connect this pipe to the nozzle.

7. Take apart the piston groups until the stroke index set to the "40" division on the scale and effect 7—10 primings of slushing compound into the cylinder through the nozzle.

8. Turn over by hand the lubricator flywheel for 250—300 revolutions with the piston groups being simultaneously taken together and apart up to the stop for at least five times.

9. Bring the pistons apart for 150 mm shown by the stroke index, place the accelerating plate of the fuel pump on the shaft square, fix it to the casing and make sealing.

10. Using the hand-actuated priming lever make 7—10 primings into the Diesel engine cylinder, and then pour slushing compound into the nozzle body through a slot for the control pin.

11. Through the manholes on the intermediate and 2nd—3rd casings the presence of slushing compound is checked on the motion mechanism and other units of the Diesel-driven compressor, and in case of necessity an additional layer of slushing compound is applied.

12. Remove and slush the self-acting starting mechanism by pouring slushing compound into the cylinder through the nut hole till it fills up.

Drain the excess of slushing compound by turning the mechanism with the nut hole downward. Mount the mechanism to its place.

13. Fill up the lubricator roller coupling with technical vaseline through the grease cup.

14. Remove the suction filter-silencer and apply slushing compound to the 1st stage valve cover through the suction port on the 1st stage cover.

15. Drain the slushing compound from the cavities of the lubricator, fuel pump and float chamber.

16. Accomplish hermetical sealing of the Diesel-driven compressor in the following way:

a) close all the drain cocks and scavenging valves of the Diesel-driven compressor;

b) plug the holes of the pipe connections with wooden stoppers;

c) fit a polyethylene gasket and plywood stopper under the exhaust flange (the available flange gasket should be remained);

d) wrap the filter-silencer strainer in three layers of paraffined paper and tie it with wire.

External Slushing

1. Apply slushing compound with a brush to the unpainted external metal parts of the Diesel-driven compressor and wrap them in paraffine or parchment paper.

2. Pour slushing compound into the splits between the 1st stage cover and casing, the 2nd—3rd stage head and casing, as well as the 3rd stage cover and 2nd—3rd stage head.

Note. To apply slushing compound to the coolers flexible rubberized hoses is not admitted. Before the anticorrosion treatment the hoses are to be wrapped in paraffine or parchment paper. Undesirable slushing compound on them should be removed with a clean rag.

Slushing the Spare Parts, Accessories and Tools

All the spare parts, accessories and tools, except those made of rubber, paronite and other non-metal materials, should be anticorrosion treated as follows:

a) wash the external and internal surfaces of the components with pure Diesel oil, blow over them with compressed air and wipe them dry;

b) apply slushing compound to the surfaces of the parts by dipping them in oil;

c) wrap the parts in paraffined or parchment paper and place them in the proper nests of the storage cases.

Removal of Slushing Compound

1. Remove the exhaust flange plugs, wooden stoppers from all pipe connections and unwrap the filter-silencer.

2. Wipe all the slushed external surfaces of the Diesel-driven compressor using clean rags.

3. Wash the float chamber with Diesel fuel.

4. Disconnect the high pressure pipe from the nozzle and by means of the hand-actuated priming lever wash it with Diesel fuel, then replace it.

5. Fill up the cavities of the lubricator and fuel pump with strained specified oil. Slightly release the connecting bolts of the oil pipes at the lubrication points and pump the oil by rotating the lubricator flywheel manually until oil appears around the bolts.

6. Tighten the connecting bolts and rotate the lubricator flywheel for 50 revolutions with the piston groups being simultaneously taken together and apart for 5 times.

7. Prepare the compressor for starting and start it following the instructions for operation.

All the indicated operations done, the Diesel-driven compressor is ready and fit for the normal operation.

VI. STORAGE

The Diesel-driven compressor, auxiliary units, spare parts, accessories and tools should be stored in dry and ventilated rooms with no access of corrosion causing gases and vapours. The ambient temperature in the room should be not below +5° C.

Outdoor storage of the ДК2 Diesel-driven compressor is admitted in exceptional cases only during dry and warm season for not longer than 2 months, and it should be stored in the Manufacturer's packing box.

When the packing box is damaged in transit the customer should thoroughly examine the state of anticorrosion slush on the parts. If some defects of slushing are found, reslush the parts according to the requirements of the present instructions.

The described method of slushing guarantees the Diesel-driven compressor to be safe for 12 months provided it is stored in a dry room.

Every six months the state of the slushing compound should be examined. After one year storage the slushing compound is to be renewed.

VII. INSTRUCTIONS FOR INSTALLING ДК2 DIESEL-DRIVEN COMPRESSOR ON SITE

1. To ensure normal maintenance of the Diesel-driven compressor in operation and to make possible its disassembling, the overall dimensions of the space where it is to be operated should strictly comply with the compressor delivery specifications (the outline drawing being enclosed with the Diesel compressor logbook). Particular care should be given to ensure easy access to the water pump and lubricator.

2. The Diesel-driven compressor exhaust piping should have an inner diameter of 90 mm and be devoid of abrupt bends. Its length from the compressor to the silencer should be within 1.5—2.5 metres.

When connecting the piping to the common gas exhaust system after the silencer, make sure that there is an outlet to the atmosphere designed for the Diesel-driven compressor starting. The exhaust piping should enter the piping for other engines in the direction of the flow at an angle of 30°.

3. After each Diesel-driven compressor the air piping system should be provided with a water/oil trap having a capacity of not less than 6 litres (one piece per each ДК2 Diesel compressor).

4. The storage cylinders for air designed for the Diesel-driven compressor starting should be provided with blow valves.

5. The Diesel compressor starting piping should be provided with a reduction gear to reduce the compressor air pressure from 150 kg/sq cm to 80 kg/sq cm.

6. For periodical draining sludge and for flushing the fuel tank, the latter should have a sump and a drain cock. The tank fuel take-off pipe should be located at a distance of 150—200 mm from the bottom.

To clean the fuel when filling, the fuel tank should be provided with a filter made of [illegible] gauze or better of felt).

If possible, install a fine cleaning filter (say, felt filter) in the piping between the fuel pump and fuel tank. The filter should have a capacity of 20—25 kg/hr.

7. If the water pump is installed above the level of water to be taken, mount a non-return valve in the water suction piping, locating it somewhat below the water level.

8. Provision should be made for emergency cases (such as failure of the water pump) to cool the Diesel-driven compressor from an outside source with a water pressure of 1.5—2 kg/sq.cm and water consumption through the compressor 1.6—2.2 cu.m/hr. In this case water should be delivered directly to the ~~4th~~ 2nd stage cooler (avoiding the water pump).

9. When installing the Diesel-driven compressor on a bed frame provided with shock absorbers (or some other bed plate), make sure that all the four lugs of the Diesel fit the frame pads by filing the pads or by using gaskets. The clearance permissible between a lug and a pad should not exceed 0.1 mm.

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List of modifications and errata No 1

Page	Item No	Printed	Should be read
	I	Modifications introduced in the text.	
38		....of 26 to 30...	..of 26 to 35....
43		....of 26 to 30...	..of 26 to 35....
49		.....26 ÷ 30...	....26 ÷ 35...
104		...to the 4th...	...to the 2nd...
	II	Modifications not introduced in the text	
45	12 from top	35	321
64	15 from top	Coat the external surfaces of the silencer with a temperature resistant black point.	Coat the external surfaces of the silencer.
	7 from top	Wherever damage to the filler or paint is found, the old filler or point layer should be removed. After refilling and drying, ..., oil piping pointed yellow.	Wherever damage is found, the paint coating should be restored.
	19 from bottom	5	3
	18 from bottom	3	5
	17 from bottom	Clip 12	Clip 16
	24 from botton	Remove	Drain
	16 from bottom	15. Remove	15. Drain

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